

**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

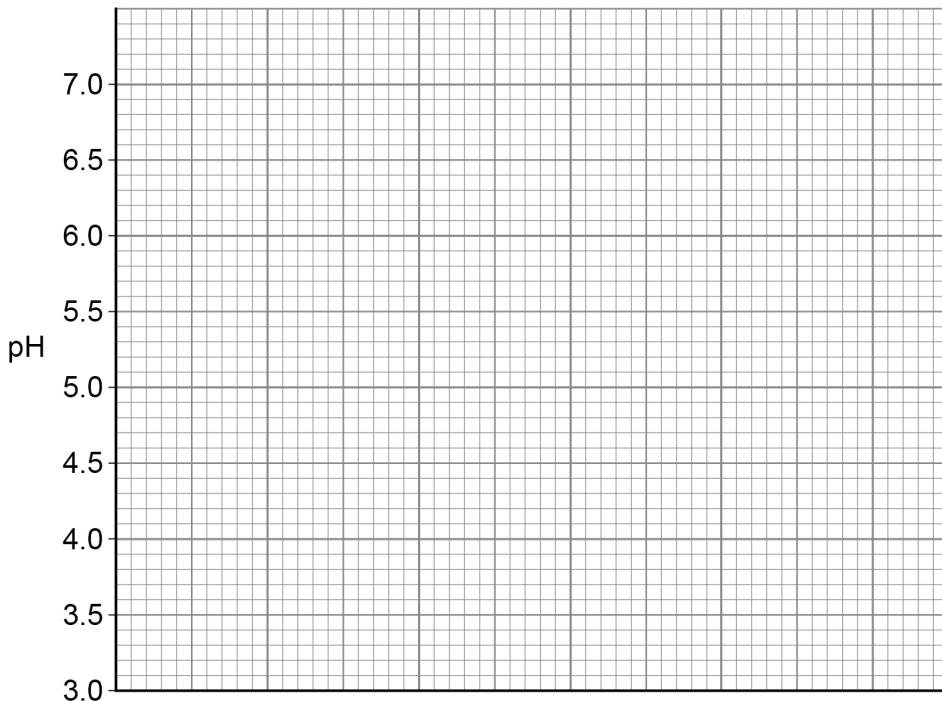
**0 2 . 3** Complete **Figure 4**.

[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]

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8



0 6

**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]**

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**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]**

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**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]**

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**Question 3 continues on the next page**

**Turn over ►**



**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		

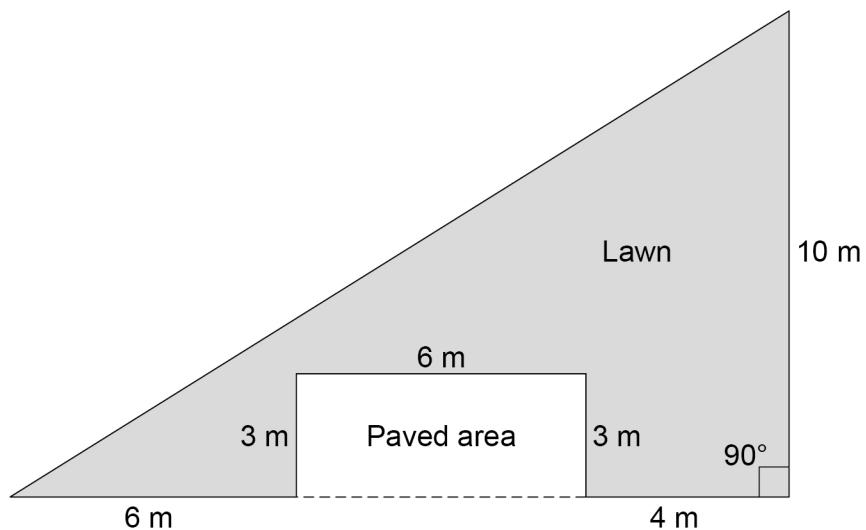
**Question 5 continues on the next page**

**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  $50\text{ cm} \times 50\text{ cm}$ .

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]**

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**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]

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

**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 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

**Turn over for the next question**

Turn over ►



*Do not write outside the box*

**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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**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]



**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 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

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

**[5 marks]**

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**16**

**Turn over for the next question**

**Turn over ►**



1 9

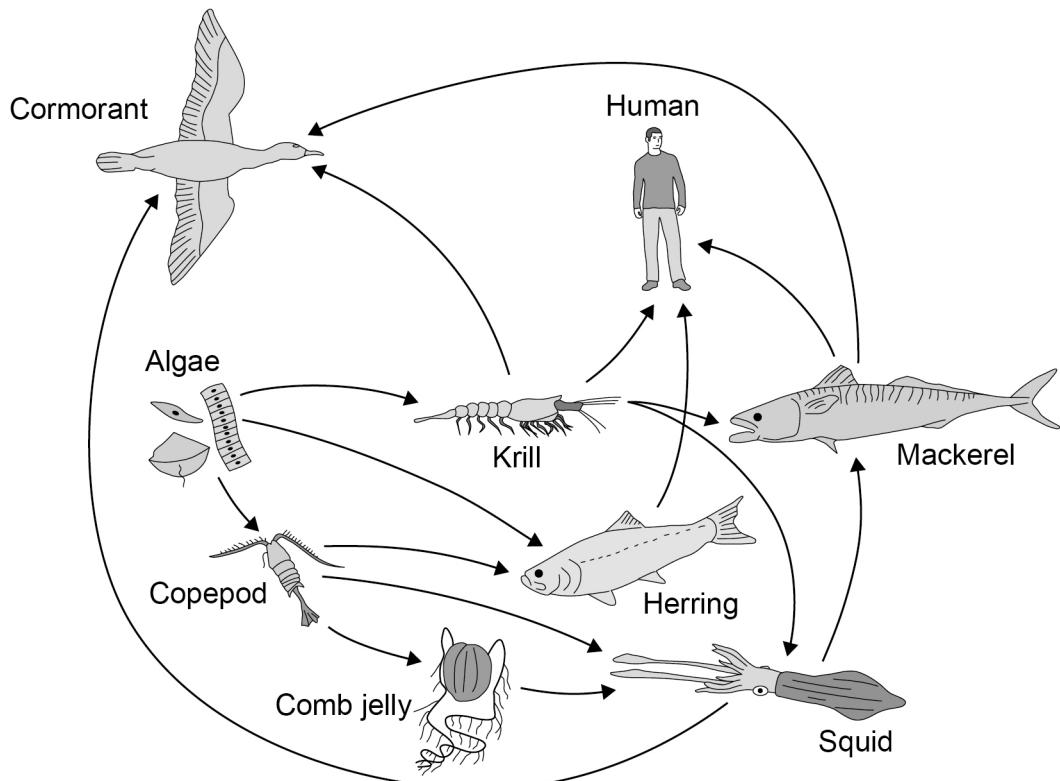
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**0 7**

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]

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**0 7 . 2**

Name **one** primary consumer in **Figure 9**.

[1 mark]

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**0 7 . 3** Name **one** producer in **Figure 9**.

[1 mark]

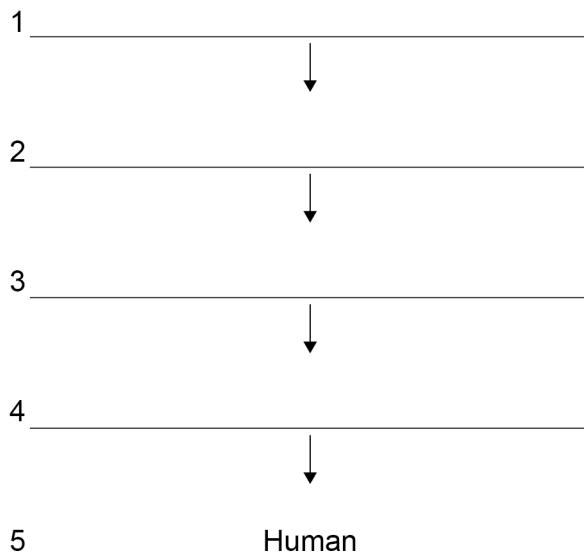
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**0 7 . 4** The different food chains in **Figure 9** have different numbers of organisms.

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

[1 mark]

**Figure 10**



**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 \_\_\_\_\_

2 \_\_\_\_\_

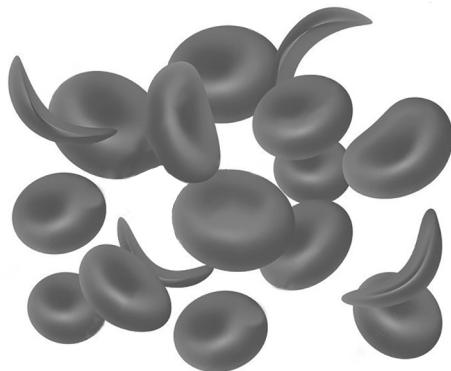
\_\_\_\_\_

**Turn over ►**



**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]**

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

**Question 8 continues on the next page**

**Turn over ►**



- 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]**

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**11**



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

**[2 marks]**

*Do not write outside the box*

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

Use information from **Figure 15**.

**[1 mark]**

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**Question 9 continues on the next page**

**Turn over ►**



3 3

IB/M/Jun21/8461/2H

**0 9 . 6****Figure 19 shows:***Do not write outside the box*

- 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]**

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**13****END OF QUESTIONS**

3 8

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

**0 | 1**

This question is about the decay of milk.

**0 | 1 . 1**

Name **two** types of microorganism that cause decay.

**[2 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

**0 | 1 . 2**

Cows' milk is pH 6.6.

As milk decays, lipids in the milk are broken down.

One of the products of the breakdown of lipids causes the pH of milk to decrease.

Name the product that causes the pH to decrease.

**[1 mark]**

\_\_\_\_\_



0 2

IB/M/Jun20/8461/2H

A student investigated the effect of temperature on the time taken for different types of milk to decay.

This is the method used.

1. Put cows' milk in six test tubes.
2. Keep each test tube at a different temperature.
3. Measure the pH of the milk in each tube every day for 12 days.
4. Record the number of days taken to reach pH 5.
5. Repeat steps 1 to 4 with goats' milk and with almond milk.

**0 1 . 3** Give **one** way the pH can be measured.

[1 mark]

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**0 1 . 4** Give **two** control variables the student should have used in this investigation.

[2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_

**Question 1 continues on the next page**

**Turn over ►**



0 3

IB/M/Jun20/8461/2H

**0 1 . 6** Describe the effect of temperature on the time taken for goats' milk to reach pH 5.

Use data from **Figure 1** in your answer.

**[2 marks]**

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**0 1 . 7** The time taken for cows' milk to reach pH 5 at 10 °C is less than the time taken for cows' milk to reach pH 5 at 5 °C.

Suggest **one** reason why.

**[1 mark]**

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**0 1 . 8** Suggest **two** reasons why the different types of milk took different lengths of time to reach pH 5.

**[2 marks]**

1

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2

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**Question 1 continues on the next page**

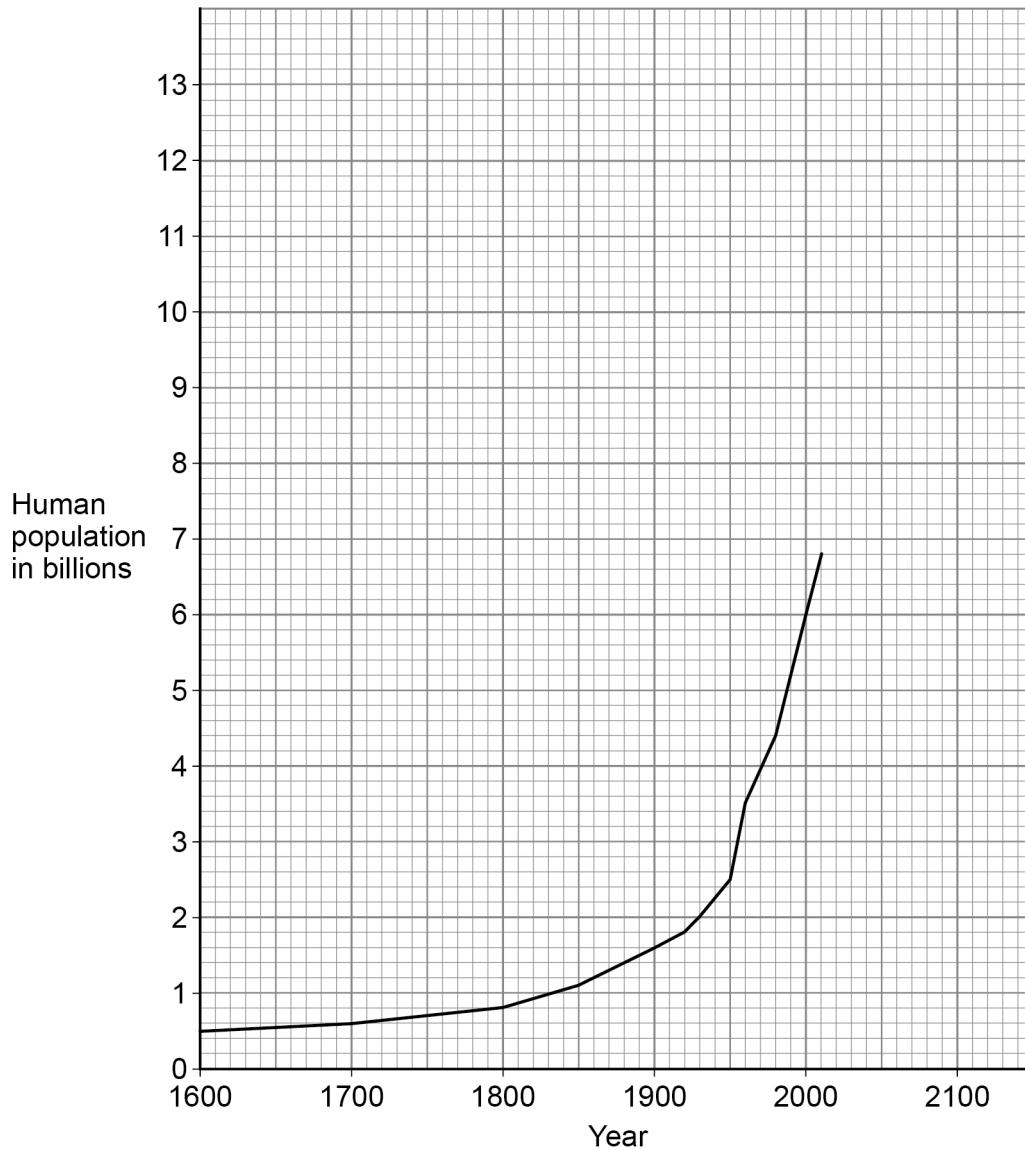
**Turn over ►**



**0 | 2**

**Figure 2** shows the human population from 1600 to 2010.

**Figure 2**



In 1900 the human population was 1.6 billion.

**0 | 2 | 1**

Calculate how many times greater the human population was in the year 2000 compared with the year 1900.

[2 marks]

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Number of times greater = \_\_\_\_\_



0 8

**0 2 . 2** In 1950 the human population was 2.5 billion.

Calculate the mean annual increase in the human population between 1900 and 1950.

[2 marks]

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Mean annual increase = \_\_\_\_\_ billion per year

**0 2 . 3** Predict the human population in 2050 if the current rate of population increase continues.

You should draw an extrapolation line on **Figure 2**.

[2 marks]

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Predicted human population = \_\_\_\_\_

**0 2 . 4** The increasing human population has caused a decline in fish stocks.

Describe how fishing quotas can help to return fish stocks to a sustainable level.

[2 marks]

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**Question 2 continues on the next page**

**Turn over ►**



**0 | 3**

This question is about plant hormones.

**0 | 3 . 1**

Farmers can spray seeds with gibberellins to start germination.

What are **two** other uses of gibberellins?

**[2 marks]**

Tick (✓) **two** boxes.

To help in tissue culture

To help roots form

To increase fruit size

To kill weeds

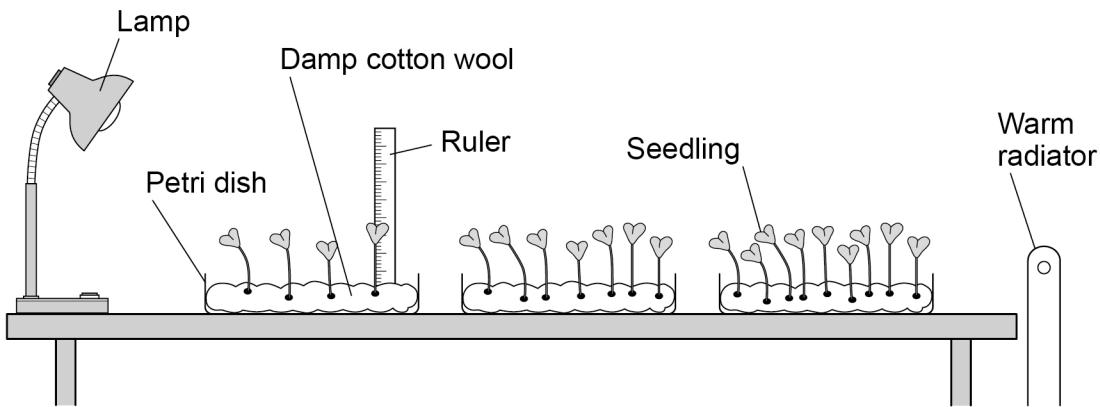
To promote flower production



Students investigated the effect of light intensity on the height of seedlings.

**Figure 3** shows the equipment.

**Figure 3**



**0 | 3 | . 2** Describe **two** improvements the students should make to their investigation.

**[2 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

**Question 3 continues on the next page**

**Turn over ►**



1 3

IB/M/Jun20/8461/2H

- 0 | 3 | 4** Explain what happened to the growth of the seedling on side **Q** compared with the growth on side **P**.

**[3 marks]**

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- 0 | 3 | 5** Bananas are often stored separately from other fruits because bananas release a plant hormone.

Why does storing bananas with other fruits cause the other fruits to ripen faster?

**[1 mark]**

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**9**

**Turn over for the next question**

**Turn over ►**



1 5

IB/M/Jun20/8461/2H

**0 5**

There are two types of cell division: mitosis and meiosis.

**0 5 . 1**

Describe **three** differences between the processes of mitosis and meiosis.

**[3 marks]**

1

2

3

**0 5 . 2**

Describe **one** similarity between the processes of mitosis and meiosis.

**[1 mark]**

**Question 5 continues on the next page**

**Turn over ►**

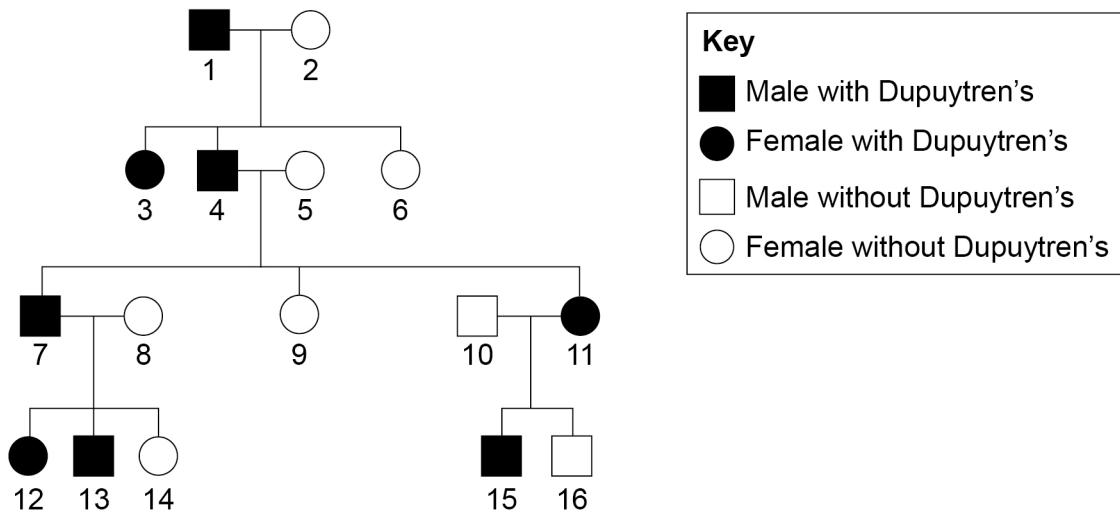
1 9

IB/M/Jun20/8461/2H

Dupuytren's is a disorder that affects the hands.

**Figure 6** shows the inheritance of Dupuytren's in one family.

**Figure 6**



Dupuytren's is caused by a dominant allele in this family.

**D** = dominant allele

**d** = recessive allele

**0 5 . 3** Give the genotype of person 1.

Explain your answer.

**[2 marks]**

Genotype \_\_\_\_\_

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**0 5 . 4** Person 7 and person 8 in **Figure 6** are expecting a fourth child.

What is the probability of the child having Dupuytren's?

You should:

- draw a Punnett square diagram
- identify which offspring have Dupuytren's

**[5 marks]**

Probability = \_\_\_\_\_

**0 5 . 5** Explain how **Figure 6** shows the allele for Dupuytren's is **not** on the Y chromosome.

**[2 marks]**

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13

Turn over for the next question

Turn over ►



2 1

IB/M/Jun20/8461/2H

**0 6 . 3** In most MRI scanners the person being scanned needs to stay completely still.

A functional MRI (fMRI) scanner allows a person to move while the scanner makes images of the person's brain activity.

Suggest how the fMRI scanner could help to find out more about the brain damage a person has.

**[3 marks]**

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**0 6 . 4** Describe how the brain receives information about light entering the eye.

You should include the names of structures in your answer.

**[3 marks]**

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**Question 6 continues on the next page**

**Turn over ►**



**0 7**

A new dog food has been developed that does **not** contain meat from cows, sheep or chickens.

The new dog food contains insects.

The insects in the dog food factory are fed on waste vegetables.

**0 7 . 1**

Sketch the pyramid of biomass for the food chain that produces food for dogs from insects.

Label the pyramid.

**[2 marks]****0 7 . 2**

Describe **two** reasons why the biomass of the insects eaten by dogs does **not** all become biomass of the dogs.

**[2 marks]**

1

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2

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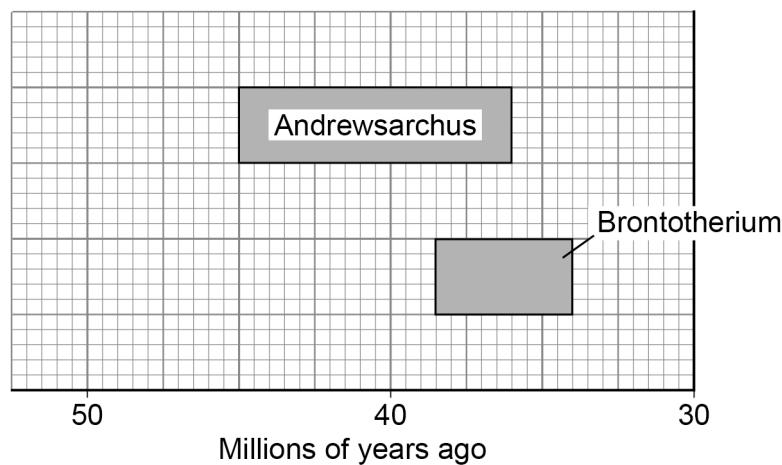
2 6

IB/M/Jun20/8461/2H

**0 8**

**Figure 8** shows when two mammals existed in Asia.

**Figure 8**

**0 8 . 1**

Determine the number of years both Andrewsarchus and Brontotherium existed together.

[2 marks]

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Time = \_\_\_\_\_ years



2 8

**0 8 . 2** The oldest fossils of human ancestors found in this area are 700 000 years old.

Andrewsarchus was a carnivore and Brontotherium was a herbivore.

Suggest how the extinction of Andrewsarchus could have resulted in the extinction of Brontotherium.

**[3 marks]**

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**0 8 . 3** Information about extinct animals is often **not** clear because the fossil record is incomplete.

Give **three** reasons why the fossil record is **not** clear for older species.

**[3 marks]**

1

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**Question 8 continues on the next page**

**Turn over ►**



**0 | 8 . 5** Give **one** disadvantage and **one** advantage of mass extinction events.

*Do not write outside the box*

Answer in terms of evolution.

**[2 marks]**

Disadvantage \_\_\_\_\_  
\_\_\_\_\_

Advantage \_\_\_\_\_  
\_\_\_\_\_

**16**

**END OF QUESTIONS**



3 2

IB/M/Jun20/8461/2H

**0 | 1**

Many human actions are reflexes.

*Do not write outside the box*

**0 | 1 . 1**

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

**[2 marks]**

Tick **two** boxes.

Jumping in the air to catch a ball

Raising a hand to protect the eyes in bright light

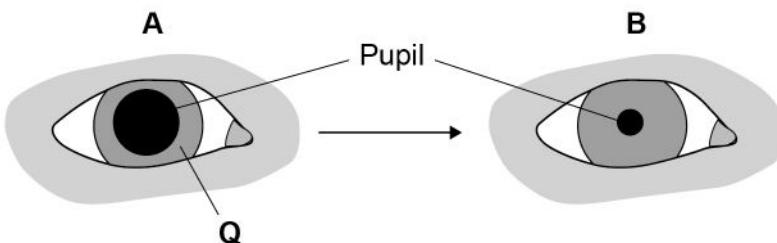
Releasing saliva when food enters the mouth

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]**


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0 2

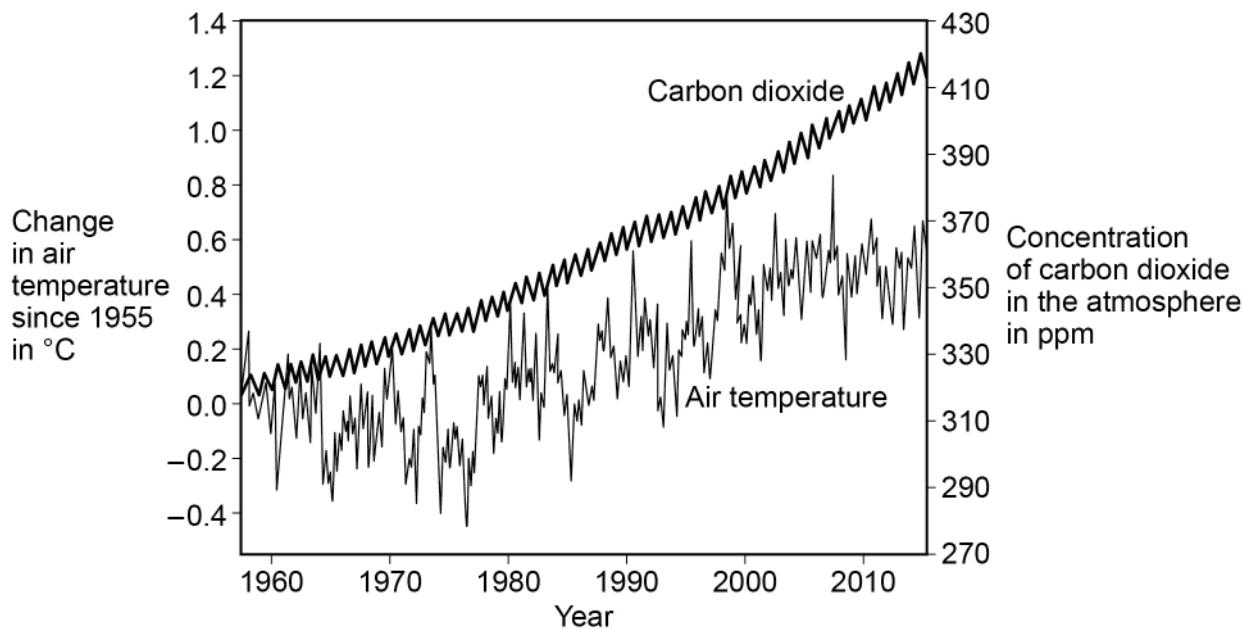
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**0 | 2**

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.

**Figure 3**

**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
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**Table 1**

	1960 – 1977	1977 – 2003	2003 – 2015
<b>Trend in carbon dioxide concentration</b>	Increasing		
<b>Trend in air temperature</b>			



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]**

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

**[1 mark]**

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

**[2 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

11



0 8

IB/G/Jun18/8461/2H

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]

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Volume lost in faeces = \_\_\_\_\_ cm<sup>3</sup>

**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

**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]**

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

**[3 marks]**

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**8**



**0 4 . 4**

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

*Do not write  
outside the  
box*

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

**[2 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

—  
**14**

**Turn over for the next question**

**Turn over ►**



1 7

IB/G/Jun18/8461/2H

**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**

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



1 8

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

2

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

**[4 marks]**

8

**Turn over ►**

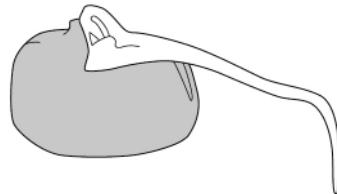


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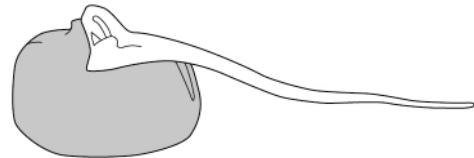
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**0 | 6 | . | 5 |** **Figure 7** shows the students' drawings of two seedlings at the end of the 2 days.

**Figure 7**



**Seedling from Apparatus A**



**Seedling from Apparatus B**

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]**

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**0 6 . 6**

In horticulture plant hormones are used for controlling plant growth.

*Do not write outside the box*

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

**[3 marks]**

**Plant hormone**

**Use of hormone**

Auxin

To reduce the time taken  
for tomatoes to ripen

Ethene

To slow down the growth of  
plant stems

Gibberellin

To promote seed  
germination

To stimulate root growth  
in plant cuttings

—  
**10**

**Turn over for the next question**

**Turn over ►**



2 3

IB/G/Jun18/8461/2H

**0 7 . 2** Calculate the percentage of the biomass lost between the algae and the large fish.

Give your answer to 2 significant figures.

**[3 marks]**

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Percentage loss = \_\_\_\_\_

**0 7 . 3** Give **one** way that biomass is lost between trophic levels.

**[1 mark]**

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**Question 7 continues on the next page**

**Turn over ►**



2 5

IB/G/Jun18/8461/2H

*Do not write  
outside the  
box*

- 0 | 8 . 3** Give the evidence from **Figure 10** which shows the percentage of fat in the milk is controlled by several genes.

**[1 mark]**

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- 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.

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]**

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**Question 8 continues on the next page**

**Turn over ►**



**0 9**

**Figure 12** shows a ring-tailed lemur.

Do not write  
outside the  
box

**Figure 12**

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

**Table 5**

Classification group	Name
Kingdom	<i>Animalia</i>
Phylum	<i>Chordata</i>
	<i>Mammalia</i>
	<i>Primates</i>
	<i>Lemuroidea</i>
Genus	<i>Lemur</i>
	<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.

Use information from **Table 5**.

**[1 mark]**

Turn over ►



3 3

IB/G/Jun18/8461/2H

**0 1 . 2** Draw a pyramid of biomass for the food chain.

Label each trophic level.

**[2 marks]**

**0 1 . 3** Give **one** reason why the total biomass of the Daphnia in the pond is different from the total biomass of the algae.

**[1 mark]**

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**Question 1 continues on the next page**

**Turn over ►**



0 3

IB/M/Jun19/8461/2H

Students investigated the size of the population of Daphnia in the pond.

This is the method used.

1. Collect 1 dm<sup>3</sup> of pond water from near the edge of the pond.
2. Pour the water through a fine net.
3. Count the number of Daphnia caught in the net.
4. Repeat steps 1–3 four more times.

**Table 1** shows the results.

**Table 1**

Sample number	Number of Daphnia in 1 dm <sup>3</sup> water
1	5
2	21
3	0
4	16
5	28

**0 1 . 4**

Calculate the mean number of Daphnia in 1 m<sup>3</sup> of pond water.

$$1 \text{ m}^3 = 1000 \text{ dm}^3$$

[2 marks]

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Mean number of Daphnia in 1 m<sup>3</sup> of pond water = \_\_\_\_\_



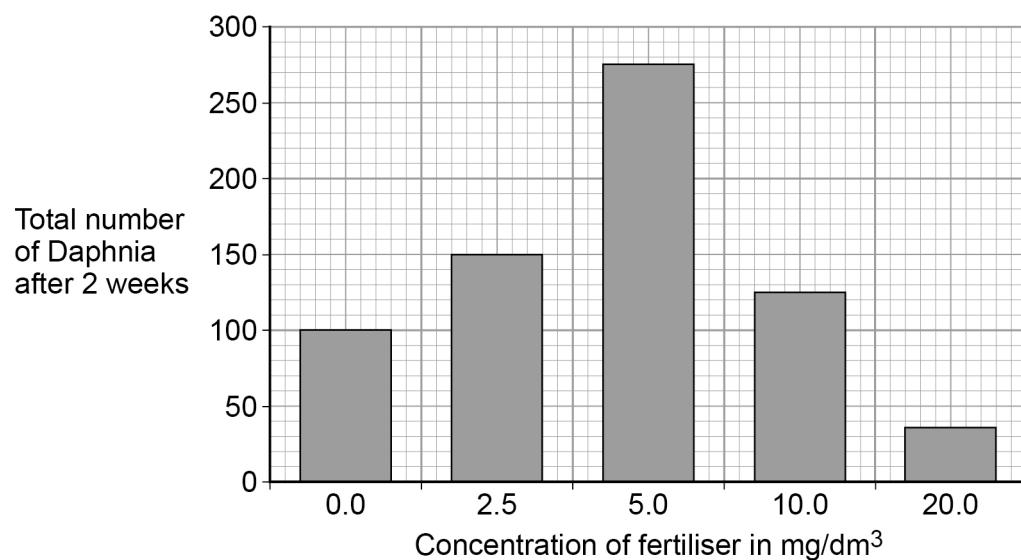
Rainfall can cause fertiliser to be washed from farmland into a pond.

The students investigated the effect of fertiliser on the population of Daphnia in water from the pond.

- The students put 20 Daphnia in each of five different concentrations of fertiliser.
- The students counted the total number of Daphnia in each concentration of fertiliser after 2 weeks.

**Figure 2** shows the results.

**Figure 2**



- 0 | 1 | 6** A concentration of 5.0 mg/dm<sup>3</sup> of fertiliser caused a large increase in the population of Daphnia.

Explain why.

[2 marks]

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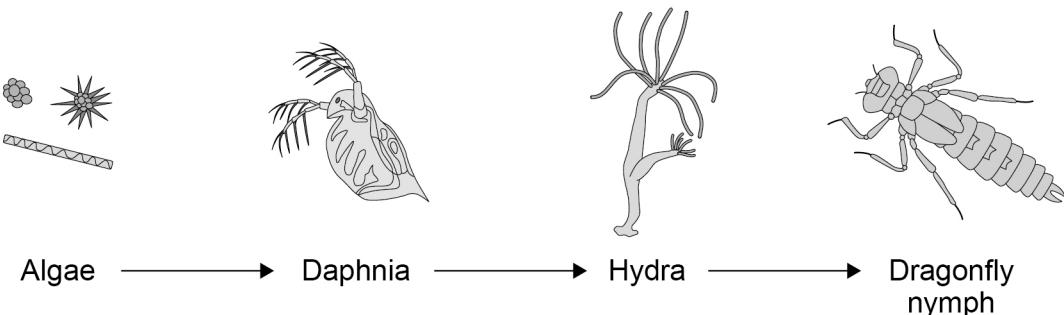
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0 1 . 7 **Figure 1** is repeated below.

Do not write  
outside the  
box

**Figure 1**



The population of **Hydra** will decrease when 20 mg/dm<sup>3</sup> of fertiliser is added to the pond.

Explain why.

[2 marks]

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14

**Turn over for the next question**

**Turn over ►**



0 7

IB/M/Jun19/8461/2H

**0 2**

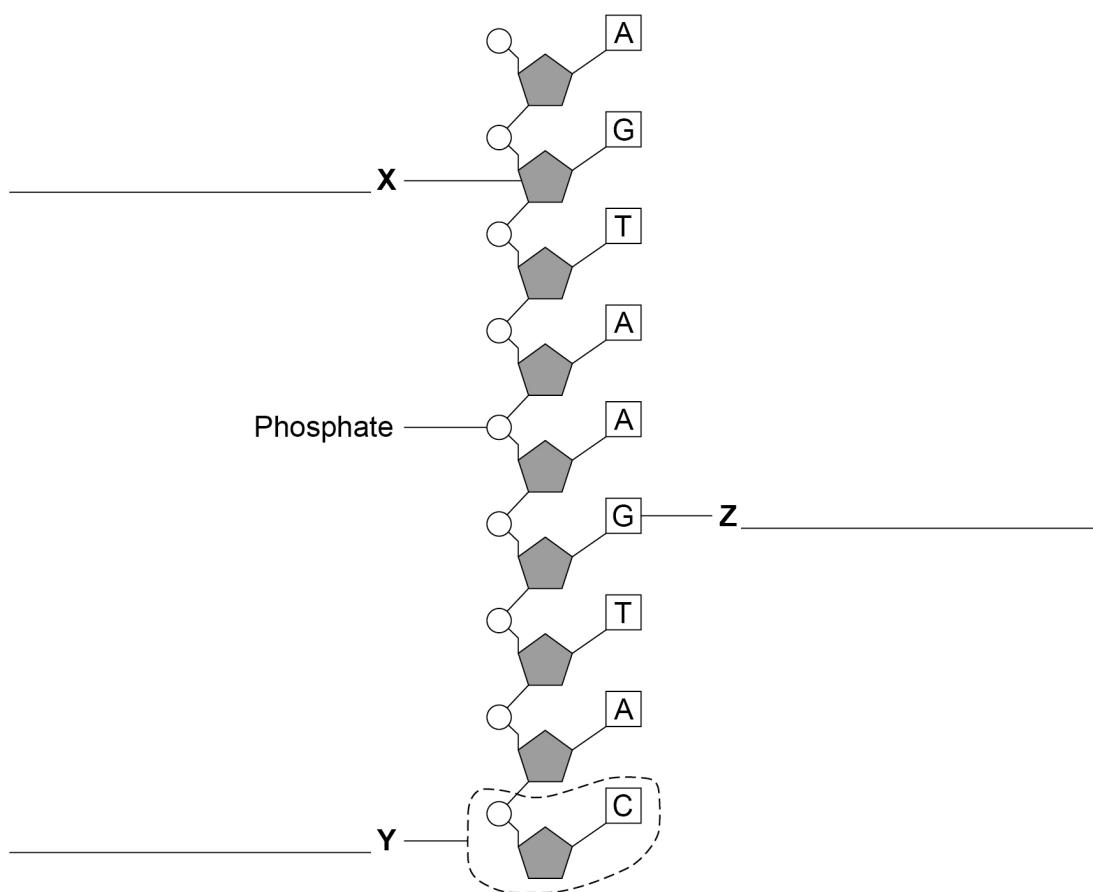
Genetic material is made of DNA.

**0 2 . 1**

Which structures in the nucleus of a human cell contain DNA?

**[1 mark]**


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**Figure 3** shows part of one strand of a DNA molecule.**Figure 3****0 2 . 2**Label parts **X**, **Y** and **Z** on **Figure 3**.**[3 marks]**

Choose answers from the box.

<b>Base</b>	<b>Fatty acid</b>	<b>Nucleotide</b>	<b>Sugar</b>	<b>Glycerol</b>
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0 8

IB/M/Jun19/8461/2H

**0 2 . 3** A complete DNA molecule is made of two strands twisted around each other.

What scientific term describes this structure?

[1 mark]

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**0 2 . 4** DNA codes for the production of proteins.

A protein molecule is a long chain of amino acids.

How many amino acids could be coded for by the piece of DNA shown in **Figure 3**?

[1 mark]

Tick (✓) one box.

2

3

9

18

**0 2 . 5** Scientists have now studied the whole human genome.

Give **two** benefits of understanding the human genome.

[2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_

8

**Turn over for the next question**

**Turn over ►**



0 9

IB/M/Jun19/8461/2H

**0 3**

Phototropism is a growth response by part of a plant to light.

**0 3 . 1**

Name **one** other tropism.

Give the stimulus the plant responds to in the tropism you have named.

**[2 marks]**

Tropism \_\_\_\_\_

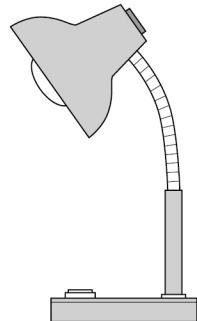
Stimulus \_\_\_\_\_

**0 3 . 2**

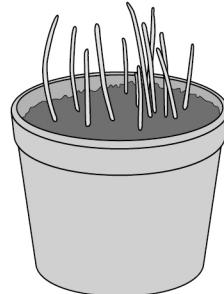
Plan an investigation to show the effect of light from one direction on the growth of plant seedlings.

Include details of any controls needed.

You may use some of the equipment shown in **Figure 4** and any other laboratory apparatus.

**[6 marks]****Figure 4**

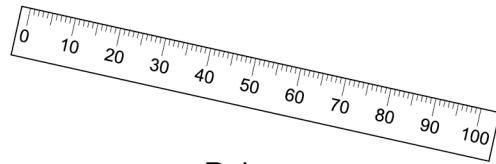
Lamp



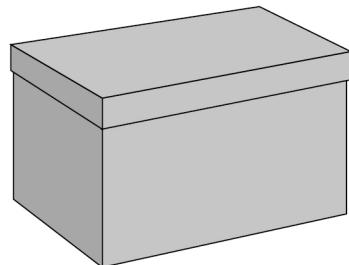
Several pots of seedlings



Scissors



Ruler



Cardboard boxes with lids



1 0

*Do not write outside the box*

**0 3 . 3** Explain how phototropism in a plant shoot helps the plant to survive.

[3 marks]

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Turn over ►



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**0 4 . 2** Explain why a long-sighted person has difficulty seeing near objects clearly.

**[2 marks]**

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**0** **4**. **3** Long-sightedness can be corrected by wearing spectacles.

Describe how spectacle lenses can correct long-sightedness.

**[3 marks]**

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Turn over ►



Use the following symbols for alleles in your answers to Questions **05.2** to **05.4**:

**Pea plants**

R = allele for red flowers  
r = allele for white flowers

**Snapdragon plants**

C<sup>R</sup> = allele for red flowers  
C<sup>W</sup> = allele for white flowers

**0 5 . 2** What is the genotype of the red-flowered pea plants in the F<sub>1</sub> generation?

[1 mark]

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**0 5 . 3** What is the genotype of a white-flowered snapdragon plant?

[1 mark]

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A gardener crossed two pink-flowered snapdragon plants.

**0 5 . 4** Draw a Punnett square diagram to show why only some of the next generation plants had pink flowers.

Identify the phenotypes of all the offspring plants.

[3 marks]

**0 5 . 5** What percentage of the offspring would you expect to have pink flowers?

[1 mark]

Percentage = \_\_\_\_\_ %

Turn over ►



1 5

**0 5 . 6** Give a reason for each of the following steps shown in **Figure 7**.

**[5 marks]**

**Several** groups of cells are scraped off the leaf: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Nutrients** are added to the agar jelly: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Hormones** are added to the agar jelly: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

The plant cells are kept in **sterile** conditions: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

The plant cells are kept at **20 °C**: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**0 5 . 7** Explain why the method shown in **Figure 7** produces **only** pink-flowered plants.

**[2 marks]**

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**0 6 . 3** A man is walking across a desert.

The man has used up his supply of drinking water.

Explain how the gland you named in Question **06.1** and the kidneys reduce water loss.

**[3 marks]**

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**Question 6 continues on the next page**

**Turn over ►**



**0 7 . 3** After 12 hours, the rate of reproduction decreased.

Suggest **three** ways the scientists could maintain a high rate of reproduction in the bacterial culture.

**[3 marks]**

1

2

3

**0 7 . 4** The rate of reproduction of the bacteria is fastest at 7 hours.

How many times faster is the rate of reproduction at 7 hours than the rate at 12 hours?

**[4 marks]**

Rate at 7 hours is \_\_\_\_\_ times faster.

**Question 7 continues on the next page**

**Turn over ►**



- 0 7 . 5** Scientists transferred a gene for resistance to the herbicide glyphosate into the bacteria.

The genetically-modified (GM) bacteria can then transfer the glyphosate-resistance gene to a crop plant.

Explain the advantage of making crop plants resistant to glyphosate.

**[3 marks]**

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**15**



**0 8**

It is important to keep the blood glucose concentration within narrow limits.

**0 8 . 1**

A person eats a meal containing a lot of carbohydrate. This causes an increase in the person's blood glucose concentration.

Explain how the hormones insulin **and** glucagon control the person's blood glucose concentration after the meal.

**[5 marks]**

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**0 8 . 2**

The body cells of a person with Type 2 diabetes do **not** respond to **insulin**.

A person with Type 2 diabetes often has a higher blood **insulin** concentration than a non-diabetic person.

Explain why.

**[3 marks]**

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**Turn over ►**

2 5

Metformin is a drug used for treating people who have Type 2 diabetes.

Scientists investigated the effects of metformin and two other drugs, **A** and **B**.

The scientists wanted to see how the drugs affected the blood glucose concentrations of 220 people with Type 2 diabetes.

This is the method used.

1. Put the 220 people into five groups.
2. Treat each group with a different drug or combination of drugs for several weeks.
3. Give each person a meal high in carbohydrate.
4. Measure the blood glucose concentration of each person 30 minutes after the meal and again 3 hours after the meal.

**0 | 8 . 3** Suggest **three** variables that the scientists should have controlled in the investigation.

**[3 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_



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

**0 | 1**

There are two types of reproduction:

- sexual reproduction
- asexual reproduction.

**0 | 1 . 1**

Complete **Table 1** to compare sexual reproduction with asexual reproduction.

Write a tick () in the box if the statement is true.

The first row has been completed for you.

**[2 marks]**

**Table 1**

	<b>Sexual reproduction</b>	<b>Asexual reproduction</b>
Cell division occurs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Fertilisation occurs		
Genes are passed on from parent to offspring		
Offspring are genetically identical to each other		

**0 | 1 . 2**

Gametes are formed in sexual reproduction.

Name the male gamete formed in flowering plants.

**[1 mark]**

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**Question 1 continues on the next page**

**Turn over ►**



0 3

IB/M/Jun22/8461/2H

**0 1 . 4** Cells divide twice during meiosis.

Which **two** times in **Figure 1** show one cell dividing into two cells?

[2 marks]

Tick (✓) **two** boxes.

3 hours

4 hours

5 hours

6 hours

8 hours

**0 1 . 5** What is the mean mass of DNA in arbitrary units in a sperm cell?

[1 mark]

Tick (✓) **one** box.

2

4

8

16

**0 1 . 6** What is the mean mass of DNA in arbitrary units in each cell in an embryo?

[1 mark]

Tick (✓) **one** box.

2

4

8

16

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8

Turn over for the next question

Turn over ►



0 5

IB/M/Jun22/8461/2H

**0 | 3 . 2** Explain the effect a high concentration of insulin has on blood glucose concentration.  
**[3 marks]**

Effect \_\_\_\_\_

Explanation \_\_\_\_\_  
\_\_\_\_\_

**Question 3 continues on the next page**

**Turn over ►**



0 9

IB/M/Jun22/8461/2H

**0 3 . 5** Person C is obese.

A doctor thinks that person C has Type 2 diabetes.

The doctor tests a sample of blood from person C.

**Table 2** shows:

- the results of the blood test
- the mean results for people who do **not** have diabetes.

**Table 2**

Concentration in blood		
	Person C	Mean for people who do not have diabetes
Cholesterol in mmol/dm <sup>3</sup>	6.21	5.20
Glucose in mmol/dm <sup>3</sup>	9.56	4.51
Insulin in arbitrary units	24.32	14.83

Type 2 diabetes occurs when body cells have a reduced response to insulin.

Give **two** ways the results of the blood test show that person C might have Type 2 diabetes.

**[2 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_



**0 3 . 6**

Give **two** ways that a person can reduce the chance of developing Type 2 diabetes.

**[2 marks]**

1

2

**10**

**Turn over for the next question**

**Turn over ►**

1 3

IB/M/Jun22/8461/2H

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**0 4**

The rapid growth in human population means that more waste substances are released into the environment.

The release of substances into the environment can cause pollution.

**0 4 . 1**

Name **one** harmful substance that could cause air pollution.

**[1 mark]**

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**0 4 . 2**

Name **three** harmful substances that could cause water pollution.

Do **not** refer to plastic or to litter in your answer.

**[3 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_



Scientists can analyse blood samples or urine samples to see if a person has MSUD.

The test identifies high concentrations of toxic substance P, shown in **Figure 5**.

- 0 | 5 . 4** Explain why the **blood** of a person with MSUD will have a high concentration of toxic substance P.

Use information from **Figure 5**.

**[3 marks]**

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- 0 | 5 . 5** Explain why the **urine** of a person with MSUD will have a high concentration of toxic substance P.

**[2 marks]**

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**Question 5 continues on the next page**

**Turn over ►**



**0 5 . 6** Explain why a person with MSUD must have a low-protein diet.

**[3 marks]**

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outside the  
box*

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**14**



2 0

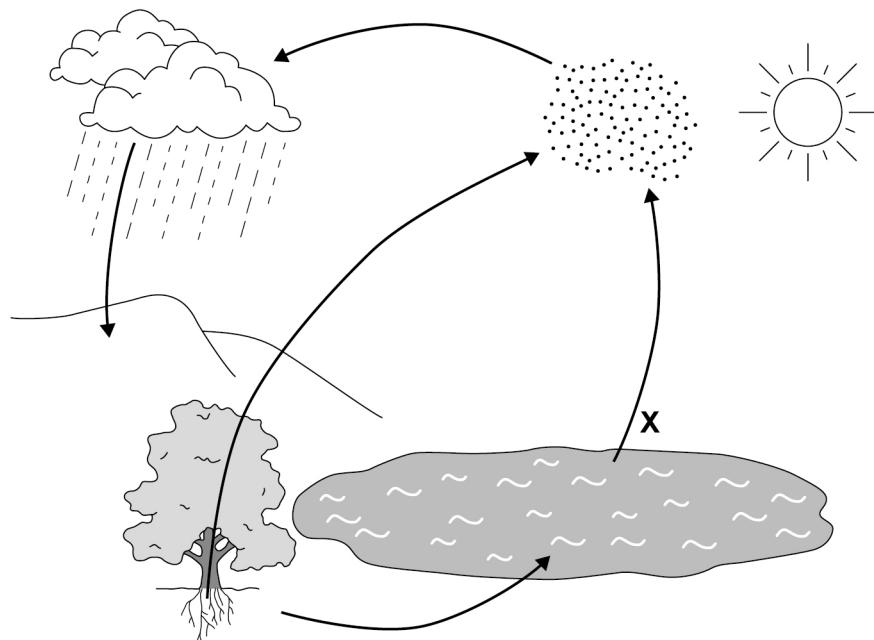
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**0 6**

Energy flows through an ecosystem and materials are recycled.

**Figure 6** shows the water cycle.

**Figure 6**

**0 6 . 1**

Name process X.

[1 mark]

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**0 6 . 2**

Name the process by which water is absorbed into plant roots.

[1 mark]

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**0 6 . 3**

Give **two** uses of water in plants.

[2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_

**Turn over ►**



**0 6 . 5** It is more energy-efficient to rear cows indoors than to rear cows outdoors.

Give **two** reasons why.

**[2 marks]**

1 \_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_

**0 6 . 6** Suggest **two** possible disadvantages of rearing cows indoors.

**[2 marks]**

1 \_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_

**13**



- 0 7 . 4** Suggest why the scientist diluted the pond water before placing it on the special slide.  
**[1 mark]**

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- 0 7 . 5** A student repeated the scientist's method.

The student used a thin coverslip over the diluted pond water instead of the thick coverslip.

The liquid pulled the thin coverslip downwards slightly.

Explain how the use of the thin coverslip would affect the results for the cell count.

**[2 marks]**

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**11**



- 0 8 . 1** Compare the variation in body temperature of the echidna in warm weather with the variation in body temperature of the human.

Use data from **Figure 11** and **Figure 12**.

**[2 marks]**

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In the cold winter months, the echidna hibernates.

During hibernation:

- the echidna's body temperature decreases to below 5 °C
- the echidna sleeps for up to 17 days at a time
- the echidna's rate of metabolism slows down.

- 0 8 . 2** Explain why the decrease in body temperature is an advantage to the echidna during hibernation.

**[2 marks]**

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**Question 8 continues on the next page**

**Turn over ►**



**0 8 . 3** During hibernation the echidna wakes up several times.

Each time the echidna wakes up it becomes active and its body temperature increases to over 30 °C.

Explain why the echidna has a higher body temperature when it is active.

**[2 marks]**

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**0 8 . 4** An echidna can dilate and constrict blood vessels in its skin.

Explain how the **dilation** of blood vessels in the skin can help to decrease body temperature.

**[3 marks]**

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An athlete trained in a hot climate.

The athlete lost a large volume of water each day in sweat.

**0 8 . 5** The athlete's energy intake each day from food was 20 000 kJ.

Evaporation of 1 cm<sup>3</sup> of sweat requires 2.5 kJ of energy.

40% of the athlete's daily energy intake was used to evaporate sweat.

Calculate the volume of sweat the athlete lost each day.

Give your answer in dm<sup>3</sup>

$$1 \text{ dm}^3 = 1000 \text{ cm}^3$$

[3 marks]

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Volume of sweat lost in one day = \_\_\_\_\_ dm<sup>3</sup>

**0 8 . 6** Suggest why the athlete was advised to take salt tablets each day.

[1 mark]

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13

**Turn over for the next question**

**Turn over ►**



3 3

**0 9 . 1** Suggest **two** control variables the students should have used in their investigation.  
**[2 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

**0 9 . 2** Describe how experiment **B** and experiment **C** acted as controls for the investigation.  
**[2 marks]**

Experiment **B** \_\_\_\_\_

\_\_\_\_\_

Experiment **C** \_\_\_\_\_

\_\_\_\_\_

**0 9 . 3** Give **two** conclusions that the students could make from the **ink marks** on the shoot in experiment **A**.

**[2 marks]**

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

**0 9 . 4** Name the type of response shown by the seedling in experiment **A**.  
**[1 mark]**

\_\_\_\_\_

**Question 9 continues on the next page**

**Turn over ►**



**0 9 . 5** A scientist made a hypothesis:

'Light causes auxin to move from the side of the shoot nearest to the light to the side furthest from the light.'

Describe the evidence from **Figure 14** which supports the hypothesis.

**[3 marks]**

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**0 9 . 6** Another scientist made a different hypothesis:

'Light causes the breakdown of auxin.'

Give the evidence from **Figure 14** that shows that auxin is **not** broken down by light.

**[1 mark]**

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**11**

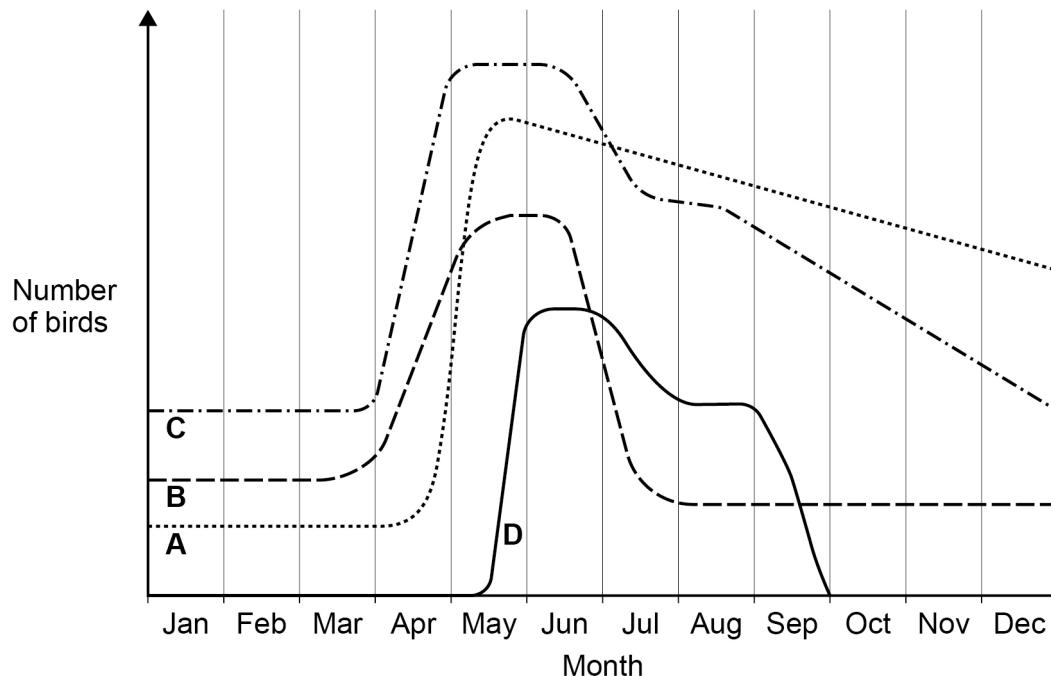
**END OF QUESTIONS**



Four other species of bird (**A**, **B**, **C** and **D**) live in a habitat in the UK.

**Figure 2** shows how the numbers of each species of bird varied during one year.

**Figure 2**



Use information from **Figure 2** to answer Questions **01.4** to **01.6**

- 0 | 1 . 4** Describe what happens to the number of birds of species **A** during the year.

**[3 marks]**

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**0 2 . 2** Which structure in **Figure 3** is where the image is focused?

[1 mark]

Tick (✓) one box.

A

B

C

D

E

**0 2 . 3** Which structure in **Figure 3** is a muscle that contracts when focusing on a near object?

[1 mark]

Tick (✓) one box.

A

B

C

D

E

**0 2 . 4** What happens to the shape of the lens when focusing on a near object?

[1 mark]

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**0 2 . 5** The eyes can function in dimly-lit areas and in brightly-lit areas.

The iris contains muscles.

Describe how muscles in the iris help the person to see clearly when moving from a dimly-lit area to a brightly-lit area.

[2 marks]

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Turn over ►



The sex of dogs is determined by **X** and **Y** chromosomes in the same way as in humans.

- 0 3 . 5** Complete the Punnett square diagram in **Figure 4** to show the inheritance of sex in dogs.

Use the symbols **X** and **Y**.

[3 marks]

**Figure 4**

			Female	

- 0 3 . 6** A female dog gave birth to six offspring.

Why would you expect there to be three male offspring and three female offspring?

Use your answer to Question **03.5**.

[1 mark]

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**Question 3 continues on the next page**

Turn over ►



Farmers keep chickens for:

- meat production
- egg production.

Some varieties of chicken grow more quickly and are more suitable for meat production.

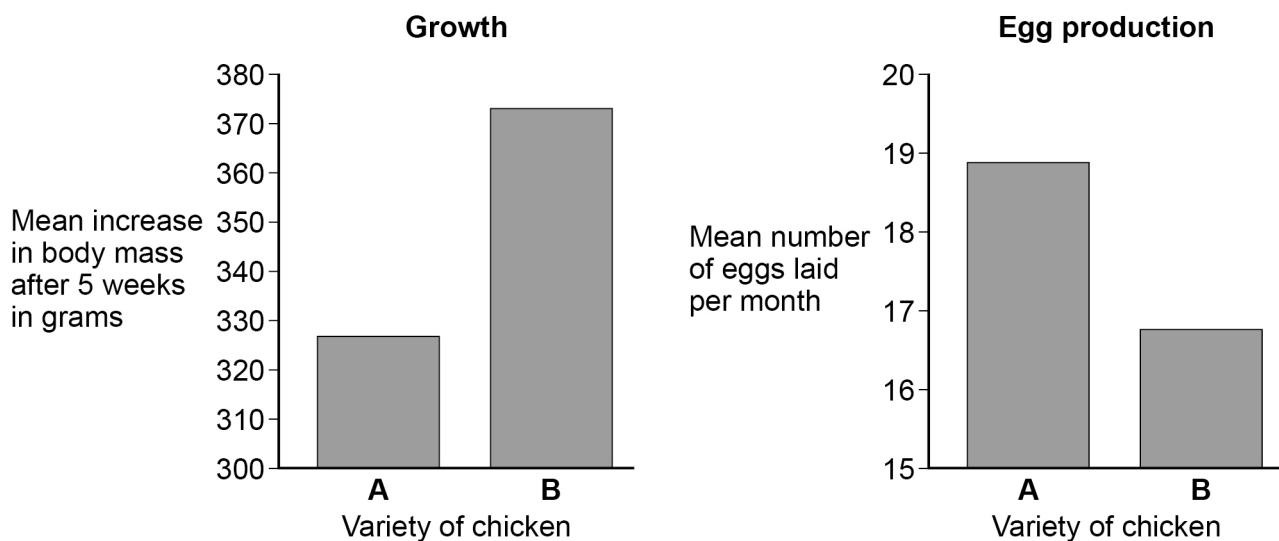
Other varieties of chicken produce more eggs.

A farmer keeps two varieties of chicken, **A** and **B**.

The farmer investigated the growth rates and egg-production rates of both varieties.

**Figure 5** shows the results.

**Figure 5**



**0 3 . 7** Suggest **two** control variables the farmer should have used in this investigation.

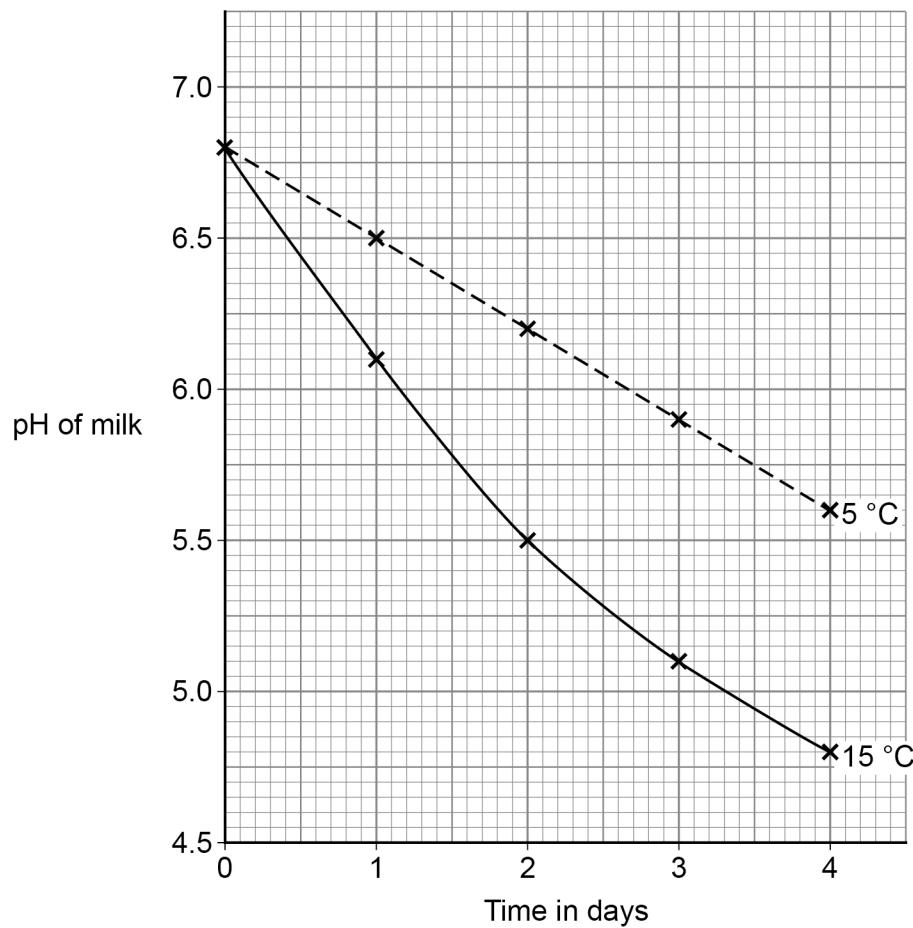
[2 marks]

- 1 \_\_\_\_\_
- \_\_\_\_\_
- 2 \_\_\_\_\_
- \_\_\_\_\_



**Figure 6** shows the results at 5 °C and at 15 °C.

**Figure 6**



**0 4 . 3** Complete **Figure 6**.

You should:

- plot the data for 25 °C from **Table 1**
- draw a line of best fit.

**[3 marks]**

**Question 4 continues on the next page**

**Turn over ►**



1 9

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**0 4 . 4** The rate of pH change increases with an increase in temperature.

The rate of pH change at 5 °C is 0.3 pH units per day.

Calculate how many times faster the rate of pH change is at 15 °C than the rate of pH change at 5 °C, at day 2.

You should draw a tangent on **Figure 7**.

[4 marks]

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**0 4 . 5** Milk contains lipids.

The lipids are broken down when the milk decays.

Explain why the pH changes more quickly when the temperature is higher.

[3 marks]

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17

**Turn over for the next question**

Turn over ►



**0 5**

Homeostasis is the regulation of the body's internal conditions.

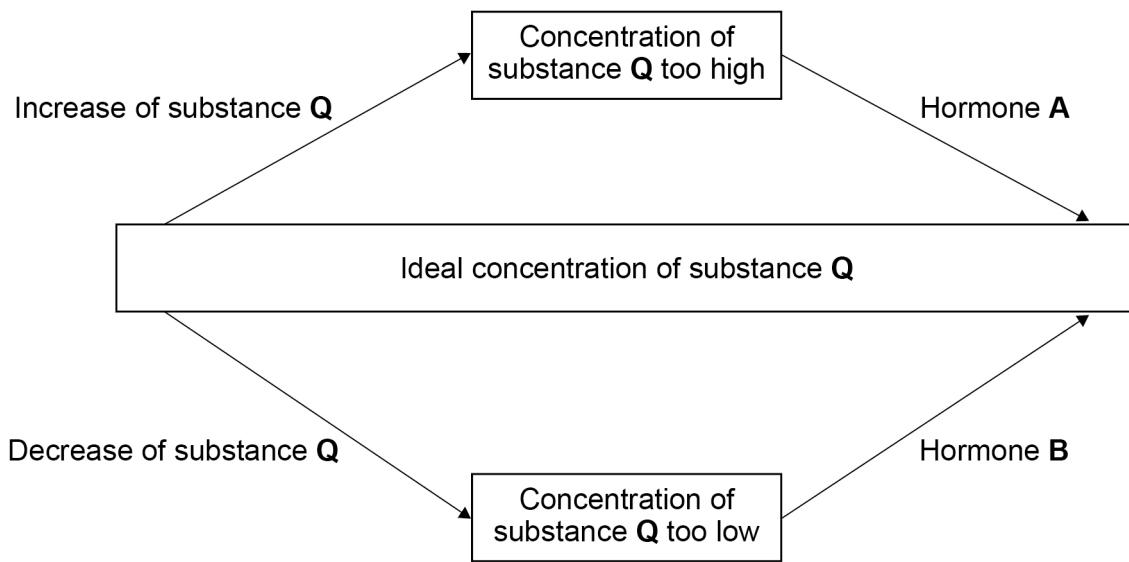
Many internal conditions are controlled by hormones.

Homeostasis works by negative feedback control.

**0 5 . 1**

**Figure 8** shows how the concentration of substance Q in the blood is controlled by negative feedback.

**Figure 8**



Explain how the concentration of substance Q in the blood is controlled by negative feedback.

Use information from **Figure 8**.

[3 marks]

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**0 5 . 2**

Thyroxine is a hormone produced by the thyroid gland.

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outside the  
box*

A decrease in body temperature causes an increase in thyroxine production.

Explain how the production of thyroxine causes an **increase** in body temperature.

**[2 marks]**

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**Question 5 continues on the next page**

**Turn over ►**



2 3

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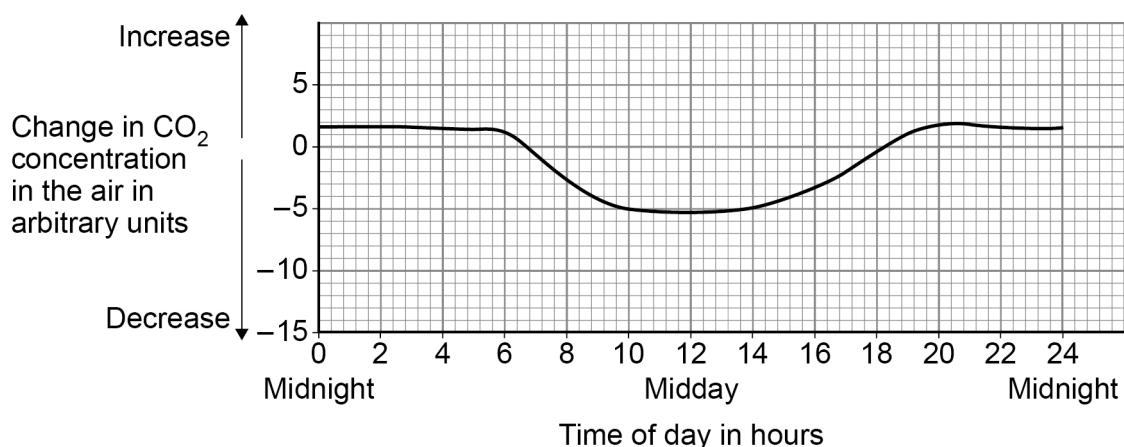
**0 6 . 2** An area of rainforest is cut down and replaced with a field of maize plants.

Only one crop of maize is grown each year.

**Figure 10** shows the changes in the carbon dioxide concentration in the air in the field of maize during one day.

The data are mean daily values over the 6-month growing period.

**Figure 10**



The maize grows for only 6 months of the year.

Explain why replacing rainforest with maize will increase the carbon dioxide concentration in the air after one year.

Use information from **Figure 9** and **Figure 10**.

**[2 marks]**

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**Question 6 continues on the next page**

**Turn over ►**



**0 6 . 3** The values plotted in **Figure 11** are percentages of the results for the control areas.

Explain why the scientists presented their results as **percentages**.

[2 marks]

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During the 100 years, the biodiversity of trees in the regenerating rainforest increases.

**0 6 . 4** Give **one** other conclusion you can make from **Figure 11**.

[1 mark]

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**0 6 . 5** Give **two** reasons why an increase in the diversity of trees in the rainforest leads to an increase in animal diversity.

[2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_

11

**Turn over for the next question**

**Turn over ►**



2 9

IB/M/Jun23/8461/2H

**0 7 . 3** Before treatment with FSH, the woman had underdeveloped breasts.

Explain why the lack of FSH in the woman's blood caused underdeveloped breasts.  
**[2 marks]**

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**0 7 . 4** Usually males and females both produce FSH.

The woman had inherited a faulty gene for FSH production from each of her parents.

The woman's parents both produce FSH.

Show how the **woman's parents** could have a child that does **not** produce FSH.

You should:

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

**H** = allele for making FSH

**h** = allele for **not** making FSH

**[3 marks]**



**0 7 . 5**

The woman continues to have injections of FSH.

*Do not write  
outside the  
box*

The woman has a child with a man who is heterozygous for the FSH gene.

Explain why the probability that the child will be able to produce FSH is 0.5.

**[3 marks]**

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**14**

**Turn over for the next question**

**Turn over ►**



3 3

IB/M/Jun23/8461/2H

At the end of meiosis the number of chromosomes is different from the number of chromosomes at the start of meiosis.

**0 8 . 2** Give the number of chromosomes in **one** cell in **Figure 13**:

- at the start of meiosis
- at the end of meiosis.

**[2 marks]**

Start \_\_\_\_\_

End \_\_\_\_\_

**0 8 . 3** Explain why the change in the number of chromosomes is important.

**[3 marks]**

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**0 8 . 4** Meiosis produces cells that are genetically different.

Describe how meiosis produces cells that are genetically different.

**[2 marks]**

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**Question 8 continues on the next page**

**Turn over ►**

