Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
BIOLOGY

H

Higher Tier

Paper 2H

Specimen 2018 (set 2)

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
- 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.

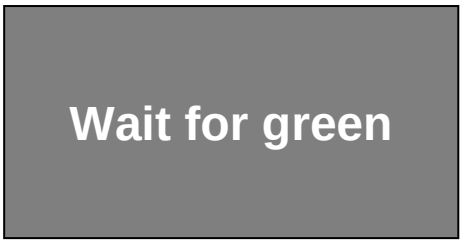
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

0 1 Three students measured their reaction times.

The students used a computer program.

Figure 1 shows the image displayed on the computer screen.

Figure 1



This is the method used:

1. Sit facing the computer screen.
2. Click the mouse button as quickly as possible when the computer screen turns green.
3. Record the time taken as shown on the computer screen.
4. Repeat steps 2 and 3 a further 9 times.

Table 1 shows the students' results.

Table 1

Attempt number	Time in milliseconds		
	Student A	**Student B**	**Student C**
1	275	260	272
2	259	268	268
3	251	251	275
4	261	256	266
5	260	244	270
6	263	280	283
7	259	468	274
8	256	258	278
9	255	255	286
10	248	277	275
Mean	259	282	275

(1 second = 1000 milliseconds)

0 1 . 1 Suggest why measuring reaction time with a computer is more accurate than measuring reaction time with a stopwatch.

[1 mark]

Question 1 continues on the next page

0 1 . 2 The students measured 10 reaction times for each person rather than 3 reaction times.

Explain why.

[2 marks]

0 1 . 3 Explain why the mean for student **B** has been calculated incorrectly.

Use information from **Table 1**.

[2 marks]

0 1 . 4 Calculate the ratio of student **C**'s mean reaction time to student **A**'s mean reaction time.

Give your answer to 3 significant figures.

[2 marks]

Ratio student **C** : student **A** = _____ : 1

0 1 . 5 Student **A** wanted to present his mean result in seconds, in standard form.

What is the correct way of doing this?

[1 mark]

Tick **one** box.

259×10^{-3} seconds ☐

0.259×10^{-3} seconds ☐

2.59×10^{-1} seconds ☐

0.259×10^{-4} seconds ☐

0 1 . 6 Student **C** said the results from this investigation showed that he had the fastest reactions.

Give **two** reasons why student **C**'s statement is **not** correct.

[2 marks]

1 _____

_____

2 _____

_____

0 1 . 7 The reaction the students investigated is **not** a reflex action.

Give the reason why.

[1 mark]

_____

_____

11

0 2 Blood is filtered in the kidneys.

Some substances are then reabsorbed.

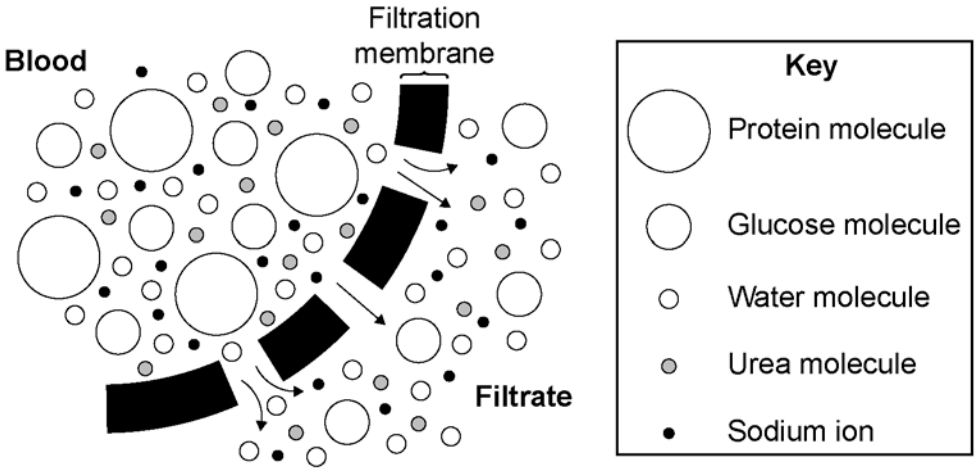
The amount of each substance reabsorbed varies.

Each day, a person:

- filters 180 dm^3 of water out of the blood
- produces 2 dm^3 of urine.

Figure 2 shows the process of filtration in the kidney

Figure 2



0 2 . 1 Explain why protein is **not** found in the urine of a healthy person.

[2 marks]

0 2 . 2 Explain why glucose is **not** found in the urine of a healthy person.

[2 marks]

0 2 . 3 Explain:

- why urea and sodium ions are found in urine
- why their concentration is higher on a hot day than on a cold day.

[3 marks]

Question 2 continues on the next page

0 2 . 4 The information below gives some features of two types of treatment for kidney disease.

Dialysis treatment

- A dialysis session lasts about 8 hours.
- A person needs 3 dialysis sessions every week for the rest of their life.
- The person must have a diet low in protein and salt.
- Dialysis costs £30 000 per year.

Kidney transplant

- A kidney transplant requires surgery using general anaesthetic.
- A suitable kidney donor is needed.
- Drugs are used to suppress the immune system.
- A transplant, and the first year's medical care, costs £51 000.
- After the first year, the cost of drugs is £5 000 per year.

Evaluate the use of a kidney transplant instead of dialysis treatment for kidney disease.

[6 marks]

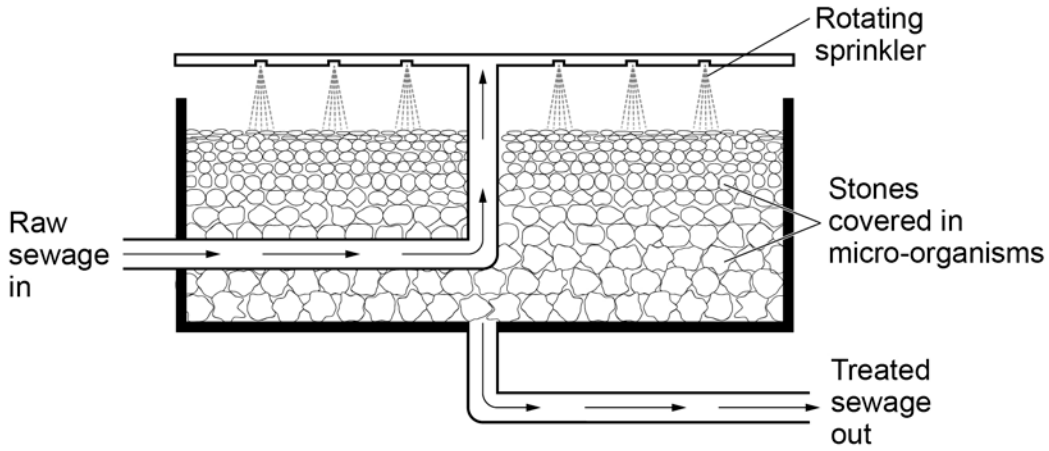
13

0 3 Pollution of rivers with untreated sewage can kill plants and animals.

Figure 3 shows a sprinkler bed at a sewage works.

The sewage trickles slowly downwards over the surfaces of the stones.

Figure 3



Some of the microorganisms on the stones feed on organic matter in the sewage.

The treated sewage is safe enough to pass into a river.

0 3 . 1 Most of the microorganisms in the sprinkler bed respire aerobically.

Describe **two** features of the sprinkler bed that encourage **aerobic** respiration.

Use information from **Figure 3**.

[2 marks]

1 _____

_____

2 _____

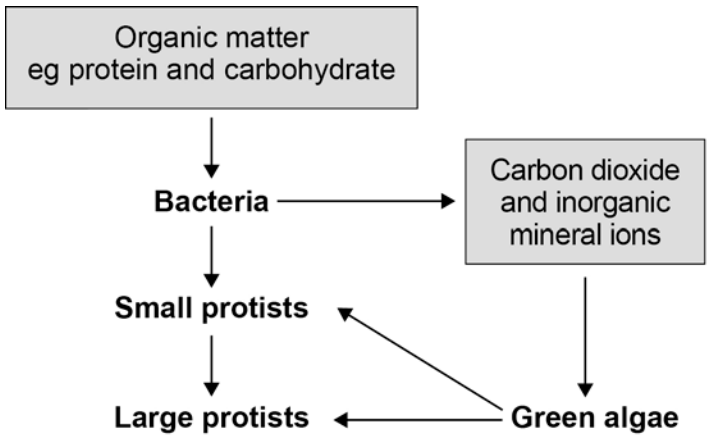
_____

Question 3 continues on the next page

Turn over ►

Figure 4 shows the feeding relationships between the microorganisms in the sprinkler bed.

Figure 4



0 3 . 2 Which organisms in **Figure 4** are producers?

[1 mark]

Tick **one** box.

Bacteria ☐

Green algae ☐

Large protists ☐

Small protists ☐

0 3 . 3 Name **one** organism in **Figure 4** which is both a primary and a secondary consumer.

[1 mark]

_____

0 3 . 4 The bacteria are decomposers.

Figure 4 shows that the bacteria change organic matter into carbon dioxide and inorganic mineral ions.

Describe how the bacteria do this.

[4 marks]

8

Turn over for the next question

0 4 Cows are reared for meat production.

The cows can be reared indoors in heated barns, or outdoors in grassy fields.

Table 2 shows energy inputs and energy outputs for both methods of rearing cows.

Table 2

	kJ/m^2/year		
	Energy input		**Energy output**
	Food	**Fossil fuels**	**Meat production**
Indoors	10 000	6 000	40
Outdoors	5 950	50	**X**

0 4 . 1 The percentage efficiency for rearing cows **outdoors** is 0.03%

Calculate the energy output value **X**.

Use the equation:

$$\text{percentage efficiency} = \frac{\text{energy output}}{\text{total energy input}} \times 100$$

[3 marks]

Energy output value **X** = _____ kJ/m^2/year

0 4 . 2 The percentage efficiency for rearing cows **outdoors** is 0.03%

Calculate how many times more efficient it is to rear cows indoors than to rear cows outdoors.

Use the equation from Question **04.1**.

[3 marks]

Answer = _____ times

0 4 . 3 A large amount of energy is wasted in both methods of rearing cows.

Give **two** ways in which the energy is wasted.

[2 marks]

1 _____

2 _____

0 4 . 4 Suggest **two** reasons why it is more efficient to rear cows indoors than to rear cows outdoors.

[2 marks]

1 _____

2 _____

10

Turn over ►

0 5 Many functions of the human body are controlled by chemicals called hormones.

0 5 . 1 What is a hormone?

[3 marks]

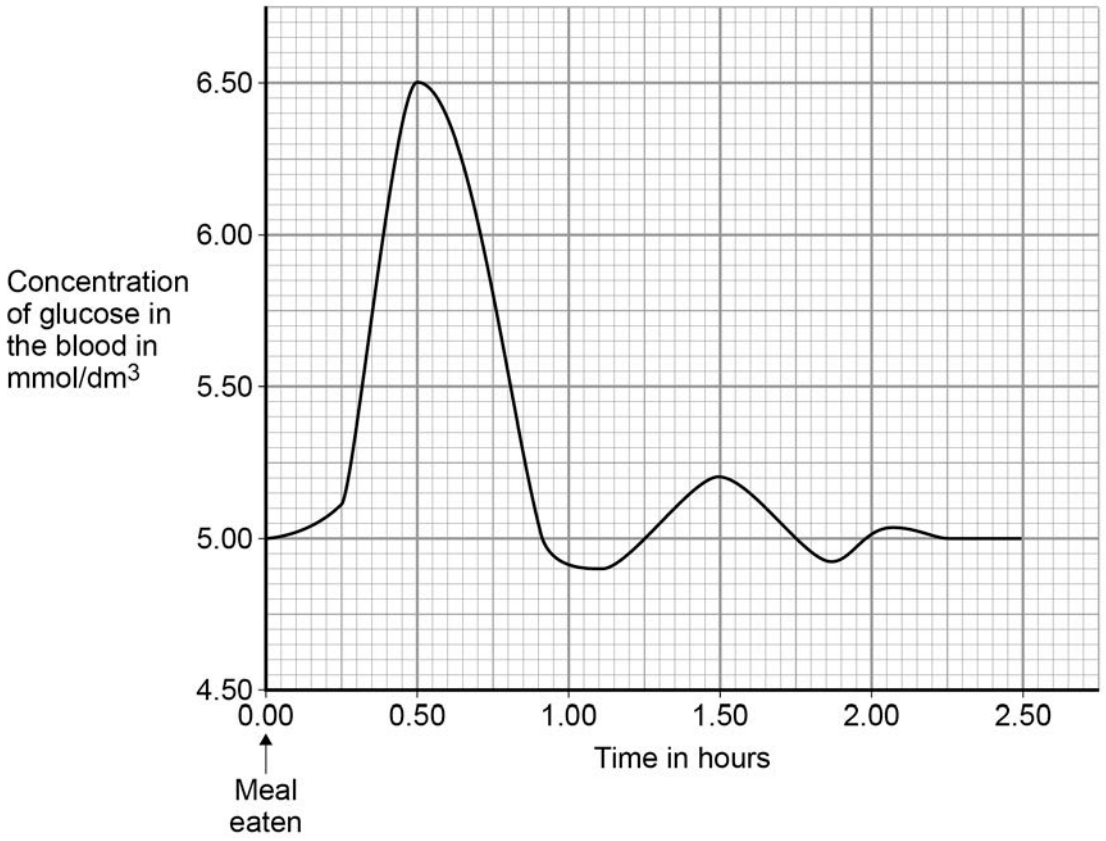
0 5 . 2 Name the **two** hormones that control blood glucose concentration.

[1 mark]

_____ and _____

Figure 5 shows changes in the concentration of glucose in the blood of a healthy person following a meal.

Figure 5



0 5 . 3 Explain how negative feedback controls the blood glucose concentration during the first one and a half hours after the meal.

[4 marks]

8

Turn over ►

There are no questions on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 6 In humans, chromosome **X** and chromosome **Y** are the sex chromosomes.

0 6 . 1 Most cells in the human body contain two sex chromosomes.

Which type of cell does **not** have two sex chromosomes?

[1 mark]

Tick **one** box.

Liver cell ☐

Muscle cell ☐

Nerve cell ☐

Red blood cell ☐

0 6 . 2 Apart from the sex chromosomes, how many **other** chromosomes are there in most human body cells?

[1 mark]

Tick **one** box.

21 ☐ 23 ☐ 44 ☐ 46 ☐

Question 6 continues on the next page

Stickler syndrome is an inherited disorder that causes damage to the eye.

One of the symptoms of Stickler syndrome is that black spaces can appear in the visual image.

0 6 . 3 Which part of the eye is affected by Stickler syndrome?

[1 mark]

Tick **one** box.

Ciliary muscles ☐

Iris ☐

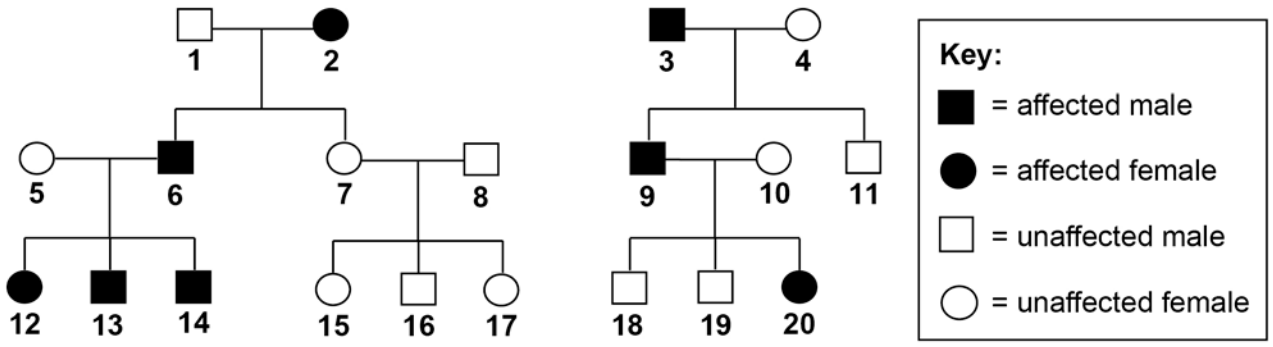
Retina ☐

Suspensory ligaments ☐

Stickler syndrome is caused by the inheritance of a dominant allele.

Figure 6 shows the inheritance of Stickler syndrome in two families.

Figure 6



Use the following symbols in your answers to Questions **06.4** and **06.5**:

A = the dominant allele for Stickler syndrome

a = the recessive allele for unaffected vision.

0 6 . 4 Explain why none of the children of persons **7** and **8** have Stickler syndrome.

[2 marks]

0 6 . 5 Person **12** marries person **18**.

Use a Punnett square diagram to find the probability that their first child will be a female with Stickler syndrome.

[4 marks]

Probability of a female child with Stickler syndrome = _____

9

Turn over for the next question

There are no questions on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 7 The limpet is a snail-like animal that lives attached to a rock on the seashore.

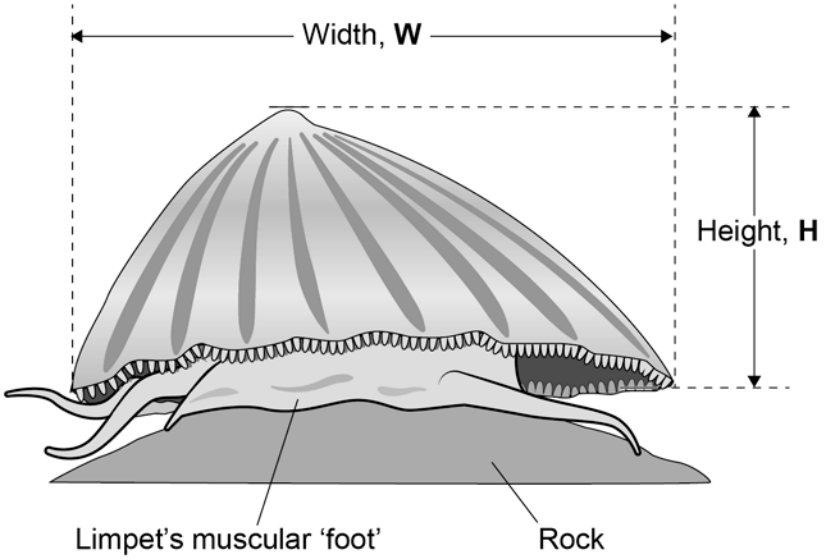
Some students investigated variation in the size of limpets living on two seashores:

- one shore was in a sheltered bay
- the other shore was exposed to the full force of the sea.

The students measured the heights (**H**) and widths (**W**) of 60 limpets on each shore.

Figure 7 shows a limpet and the measurements made by the students.

Figure 7



0 7 . 1 On each shore, the students measured a large number of limpets at random locations.

Explain why the students did this.

[2 marks]

Large number of limpets _____

_____

Random locations _____

_____

Question 7 continues on the next page

Turn over ►

The students calculated $\frac{H}{W}$ for each limpet.

Table 3 shows the students' results.

Table 3

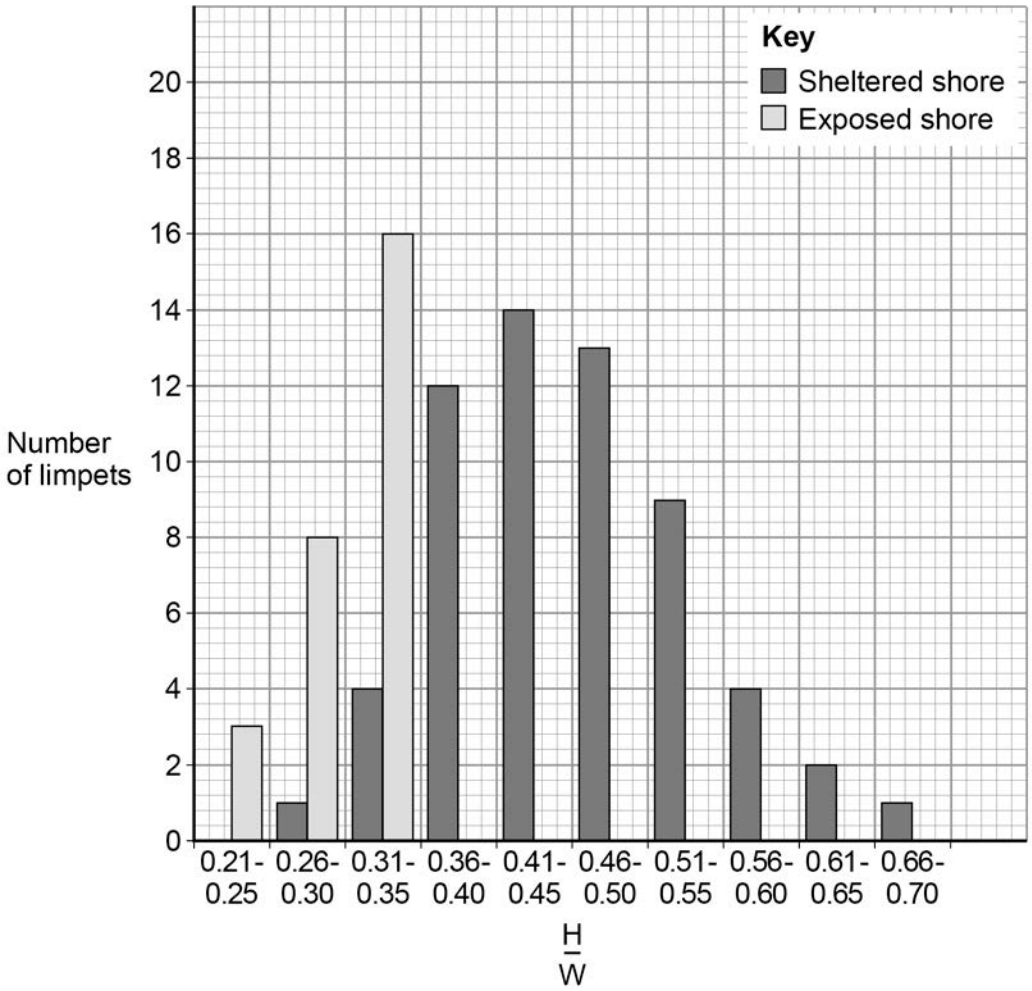
$\frac{H}{W}$	Sheltered shore		Exposed shore	
	Score	Number	Score	Number
0.21 – 0.25			|||	3
0.26 – 0.30	|	1	𝍸 |||	8
0.31 – 0.35	||||	4	𝍸 𝍸 𝍸 |	16
0.36 – 0.40	𝍸 𝍸 ||	12	𝍸 𝍸 𝍸 ||||	
0.41 – 0.45	𝍸 𝍸 ||||	14	𝍸 ||||	
0.46 – 0.50	𝍸 𝍸 |||	13	||||	
0.51 – 0.55	𝍸 ||||	9	|	
0.56 – 0.60	||||	4		
0.61 – 0.65	||	2		
0.66 – 0.70	|	1		

0 7 . 2 Complete **Table 3**.

[1 mark]

Figure 8 shows some of the results.

Figure 8



0 7 . 3 Complete **Figure 8**.

[1 mark]

0 7 . 4 Compare the patterns in the results for the exposed shore and the sheltered shore.

Use information from **Figure 8**.

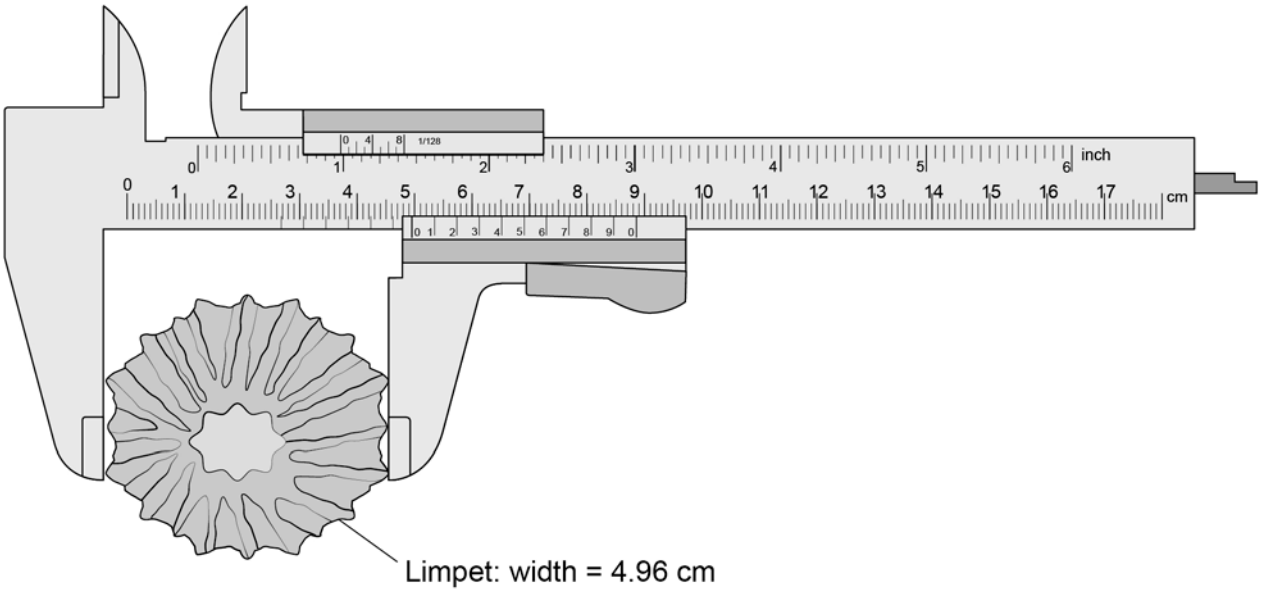
[3 marks]

Question 7 continues on the next page

Turn over ►

Figure 9 shows how the students measured the width of a limpet with a vernier calliper.

Figure 9



0 7 . 5 One student recorded

- sheltered shore: mean $\frac{\mathbf{H}}{\mathbf{W}} = 0.4659182$
- exposed shore: mean $\frac{\mathbf{H}}{\mathbf{W}} = 0.3542183$

The student's teacher stated that the data did **not** justify such a high number of decimal places.

Give the **two** mean values corrected to an appropriate number of decimal places.

[2 marks]

Sheltered shore: mean $\frac{\mathbf{H}}{\mathbf{W}} =$ _____

Exposed shore: mean $\frac{\mathbf{H}}{\mathbf{W}} =$ _____

0 7 . 6 A limpet clings to a rock on the sea shore using its muscular 'foot', as shown in **Figure 7**.

Scientists have found that limpets can exert a force of 2 newtons/cm^2 of 'foot'.

To remain attached to its rock, a limpet must exert a force at least as large as the force of the waves.

Calculate the maximum wave force the limpet shown in **Figure 9** could withstand without being knocked off its rock.

Assume that the surface of the foot is a circle.

[3 marks]

The area of a circle is πr^2.

Take the value of π to be 3.14

Maximum wave force = _____ newtons

0 7 . 7 Suggest **two** reasons why your answer to Question **07.5** might **not** be very accurate.

[2 marks]

1 _____

2 _____

Question 7 continues on the next page

0 7 . 8 Suggest biological reasons for the lower mean $\frac{\mathbf{H}}{\mathbf{W}}$ values for limpets on the exposed shore.

[3 marks]

17

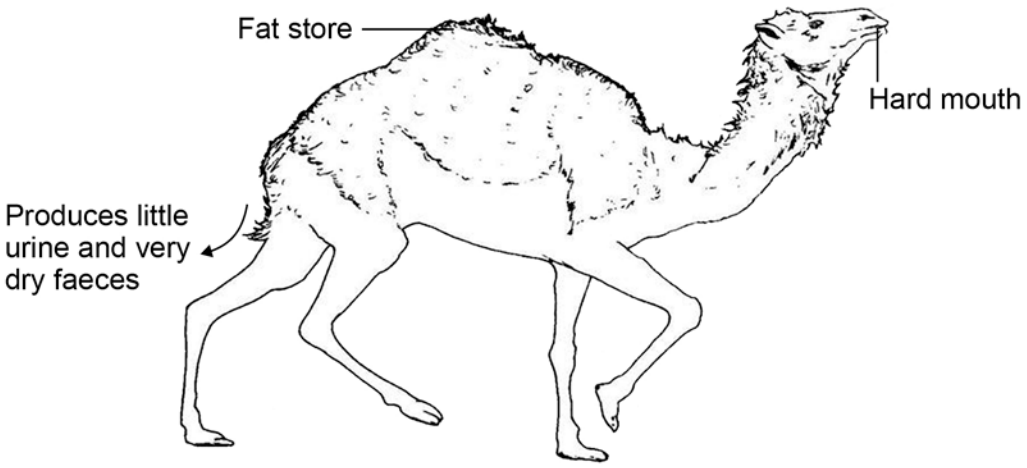
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 8 **Figure 10** shows a type of camel called a dromedary (*Camelus dromedarius*).

The dromedary lives in hot, dry deserts.

Figure 10



0 8 . 1 One adaptation of the dromedary is 'temperature tolerance'.

This means that the animal's body temperature can rise by up to 6 °C before it starts to sweat.

Explain how temperature tolerance can help the dromedary to survive in the desert.

[2 marks]

0 8 . 2 Three more adaptations of the dromedary are given in **Figure 10**.

Give a reason why each adaptation helps the animal survive in the desert.

[3 marks]

Fat store _____

_____

Produces little urine and very dry faeces _____

_____

Hard mouth _____

_____

Question 8 continues on the next page

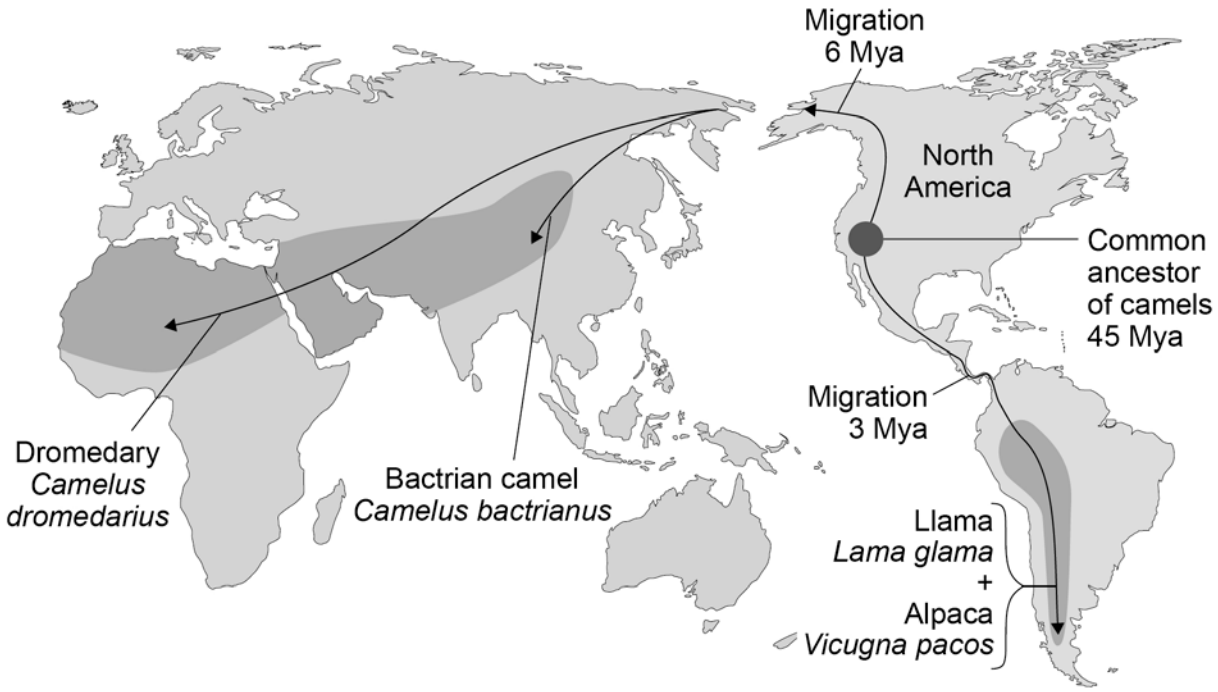
There are several species of the camel family alive today.

Scientists think these species evolved from a common ancestor that lived in North America about 45 million years ago (Mya).

Figure 11 shows:

- where four modern species of the camel family live today
- how the ancestors of these camels migrated from North America.

Figure 11



0 8 . 3 Which **two** of the four modern species of camel do scientists believe to be most closely related to each other?

Give the reason for your answer.

[1 mark]

_____ and _____

Reason _____

_____

0 8 . 4 Describe the type of evidence used for developing the theory of camel migration shown in **Figure 11**.

[2 marks]

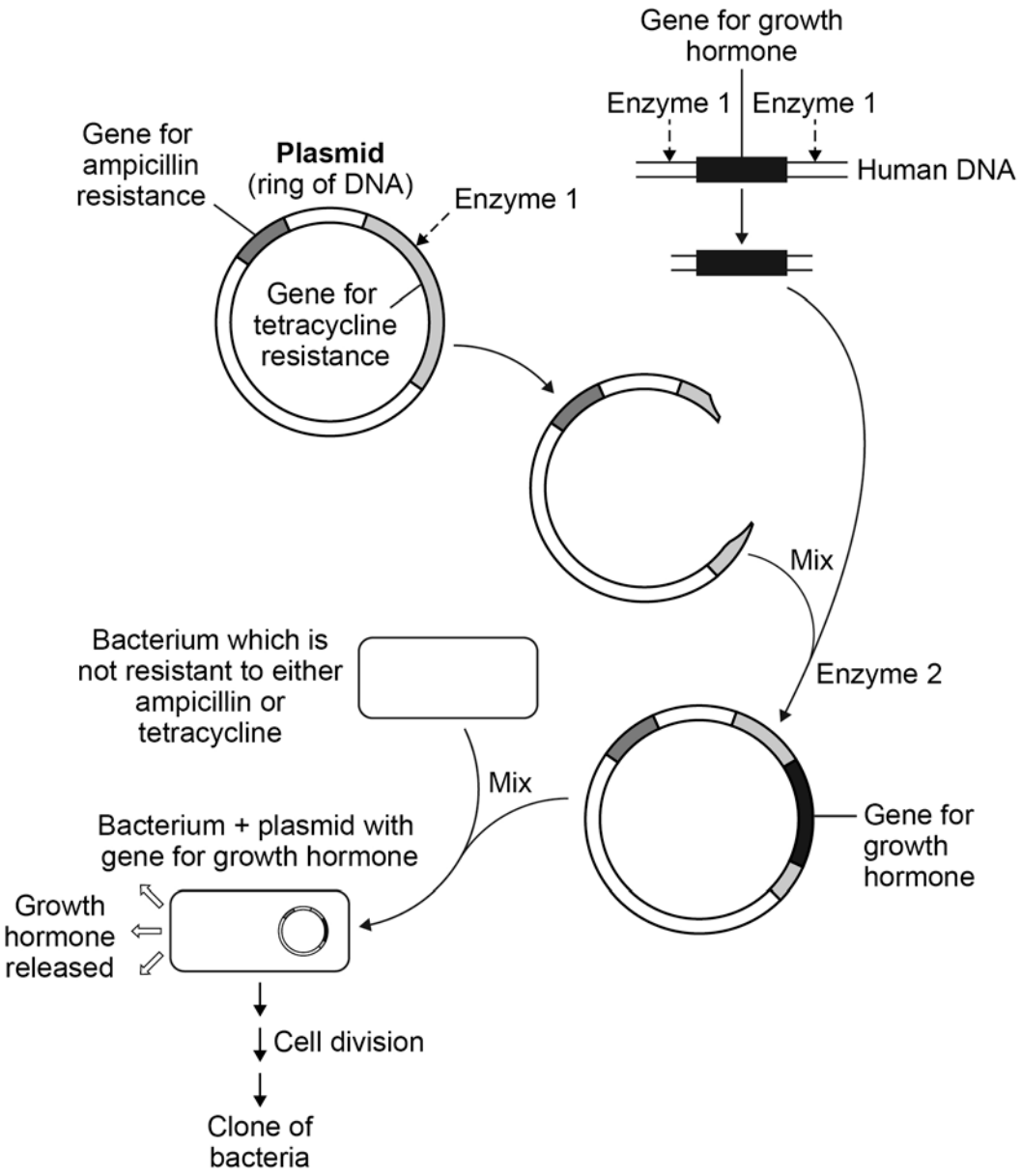
0 8 . 5 Explain how several different species of camel could have evolved from a common ancestor over 45 million years.

[6 marks]

14

0 9 **Figure 12** shows how scientists can use genetic engineering to produce human growth hormone.

Figure 12



0 9 . 1 Human growth hormone is made by the pituitary gland.

The human DNA containing the gene for growth hormone can be taken from a white blood cell.

Give the reason why the gene does **not** have to be taken from cells in the pituitary gland.

[1 mark]

Figure 12 shows that the plasmid contains two genes for antibiotic resistance:

- a gene for resistance to the antibiotic ampicillin
- a gene for resistance to the antibiotic tetracycline.

0 9 . 2 Explain how the structure of **Enzyme 1** allows it to cut the gene for tetracycline resistance, but **not** the gene for ampicillin resistance.

[3 marks]

0 9 . 3 In the final step of **Figure 12**, very few bacteria take up a plasmid containing the gene for growth hormone.

Some bacteria take up an unmodified plasmid.

Most bacteria do **not** take up a plasmid.

Complete **Table 4**.

- Put a tick in the box if the bacterium **can** multiply in the presence of the given antibiotic.
- Put a cross in the box if the bacterium **cannot** multiply in the presence of the given antibiotic.

[3 marks]

Table 4

	Bacterium can multiply in the presence of	
	Ampicillin	**Tetracycline**
Bacterium + plasmid with growth hormone gene		
Bacterium without a plasmid		
Bacterium with an unmodified plasmid		

Question 9 continues on the next page

0 9 . 4 **Figure 12** shows that the bacterium containing the gene for human growth hormone multiplies by cell division.

This produces a clone of bacteria.

Explain why **all** the bacteria in this clone are able to produce growth hormone.

[3 marks]

10

END OF QUESTIONS