AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

AS
BIOLOGY

Paper 2

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- 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.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for the questions are shown in brackets.
- The maximum mark for this paper is 75.

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

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

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0 1 . 1 What is a gene?

[1 mark]

0 1 . 2 Describe how the production of messenger RNA (mRNA) in a eukaryote cell is different from the production of mRNA in a prokaryote cell.

[2 marks]

0 1 . 3 Scientists produced a short, single-stranded, artificial nucleic acid, called PNA. The PNA binds to a small section of DNA.

The scientists introduced PNA into cells and discovered that these cells produced less mRNA than cells that did not contain PNA.

Suggest how PNA affected the transcription of the section of DNA.

[2 marks]

0 1 . 4 Describe the role of ATP in the process of translation in protein synthesis.

[2 marks]

Do not write outside the box

7

Turn over for the next question

Do not write outside the box

0 2 . 1 What term is used to describe the different structures of α-glucose and β-glucose?

[1 mark]

0 2 . 2 A student investigated the difference in the reducing sugar content of two fruit juices. He performed a biochemical test on each fruit juice using Benedict's solution. He then used a colorimeter with each test result.

Describe how the results from the colorimeter can identify the fruit juice containing the higher sugar content.

[1 mark]

0 2 . 3 The student controlled variables in the test using Benedict's solution.

Give **two** variables the student controlled.

[2 marks]

1

2

Do not write outside the box

0 2 . 4 Apples consist of flesh tissue which surrounds core tissue where the seeds are located.

A student has an apple with a mass of 180 g
The ratio of flesh tissue to core tissue in this apple is 5:1
8% of the whole apple is sugar.

Calculate the mass of sugar in the flesh tissue.

Show your working.

[2 marks]

Answer _____ g

0 2 . 5 Iodine solution stains fresh apple tissue black. When iodine solution is added to apples stored for a week, the stain is less black.

The water potential of apple juice decreases when apples are stored.

Suggest why the water potential of apple juice decreases when apples are stored.

[2 marks]

_____

_____

_____

_____

_____

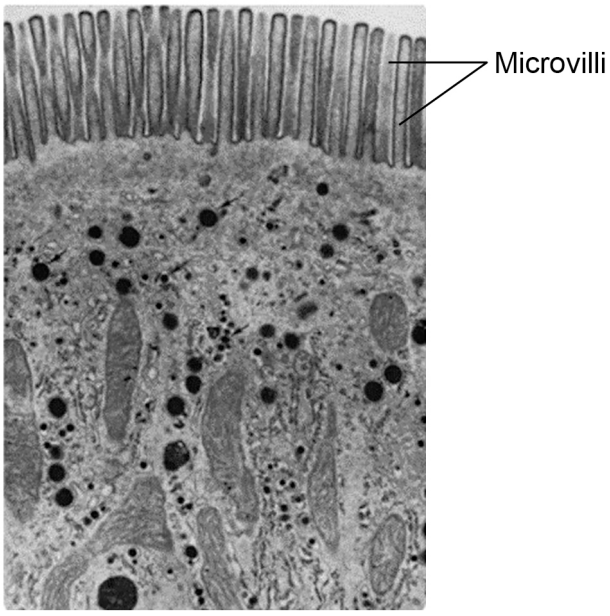
_____

8

Turn over for the next question

0 3 **Figure 1** is an image of part of a cell lining the ileum.

Figure 1



0 3 . 1 Describe and explain **two** ways that structures shown in **Figure 1** increase the rate of absorption by this cell.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

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0 3 . 2 An ileum cell **without** microvilli has 7.85 μm^2 of cell surface in contact with digested substances.

A scientist found an ileum cell with 1000 microvilli. The microvilli cover the entire cell surface in contact with digested substances.

Microvilli are 0.1 μm in diameter and 1 μm in length.
The surface area of a microvillus is calculated using this equation

$$2\pi rl + \pi r^2$$

where π is 3.14,
r is the radius,
l is the length.

Calculate the ratio of the area of the ileum cell surface **with** microvilli to the area of ileum cell surface **without** microvilli.

Show your working.

[2 marks]

Ratio _____:1

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 The protein ZO-1 is found on the surface of ileum cells.

A scientist used an anti-ZO-1 monoclonal antibody to identify ileum cells in a sample of intestine observed using an optical microscope.

Suggest how the monoclonal antibody helped the scientist to identify ileum cells in the sample of intestine.

[3 marks]

7

Do not write outside the box

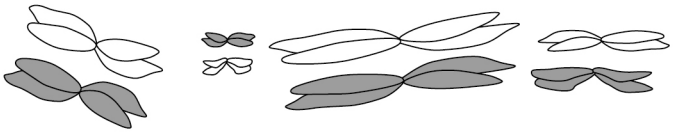
0 4 . 1 Describe how the process of meiosis results in haploid cells.
Do **not** include descriptions of how genetic variation is produced in meiosis.

[4 marks]

Question 4 continues on the next page

0 4 . 2 **Figure 2** shows the arrangement of chromosomes in a cell during the first meiotic division.

Figure 2



A scientist observed 300 cells. All of the cells were at exactly the same stage of meiosis as the cell shown in **Figure 2**.

Use your knowledge of the independent segregation of homologous chromosomes to calculate how many of these cells are expected to have an **identical arrangement** of chromosomes to those shown in **Figure 2**. Assume no crossing over occurs.

[2 marks]

Answer _____

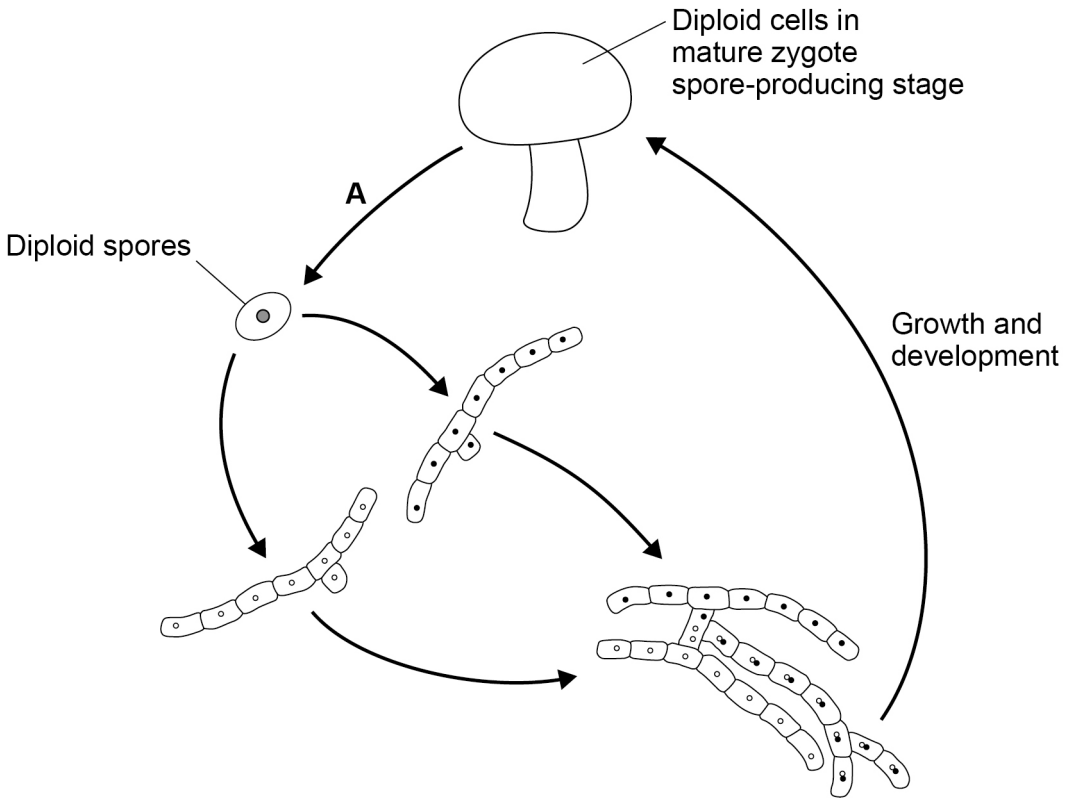
0 4 . 3 Draw a diagram to show the chromosomes in one gamete produced by meiosis from the cell shown in **Figure 2**.

[1 mark]

Do not write outside the box

0 4 . 4 **Figure 3** shows the life cycle of a fungus. The life cycle includes sexual reproduction.

Figure 3



What is the name of the process shown by arrow **A** in **Figure 3**?

Tick (✓) **one** box.

[1 mark]

Binary fission ☐

Fertilisation ☐

Meiosis ☐

Mitosis ☐

8

Turn over for the next question

0 5 . 1 Describe how organisms are grouped in a phylogenetic classification system.

[2 marks]

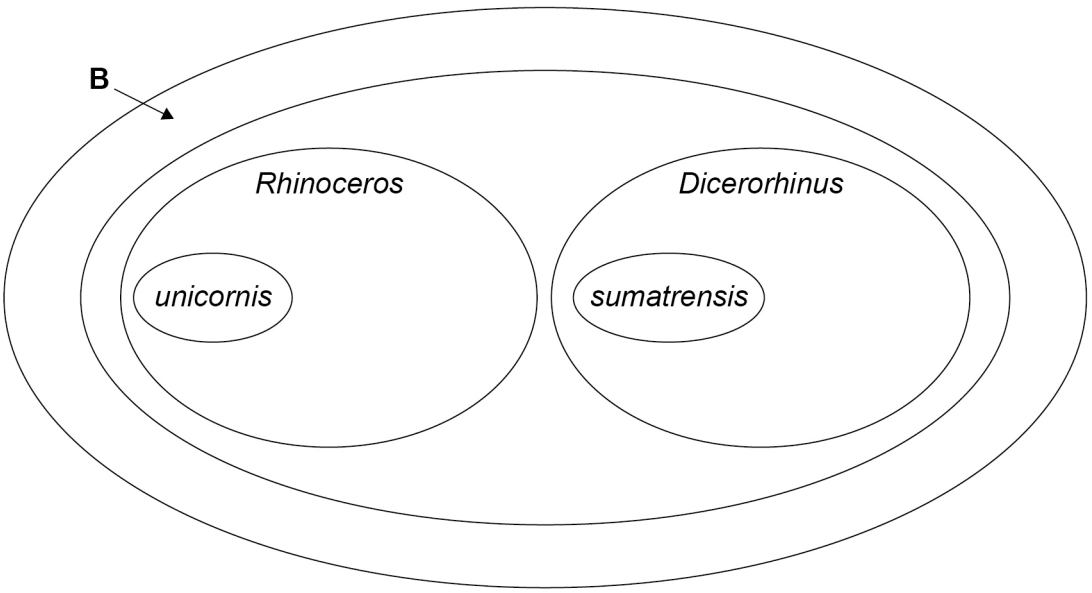
Table 1 shows some of the taxa in the phylogenetic classification of a rhinoceros species.

Table 1

Taxon name	Scientific name
Class	Mammalia
Order	Perissodactyla
Family	Rhinocerotidae
Genus	*Rhinoceros*
Species	*unicornis*

Figure 4 shows the relationship between the taxa in the classification of two rhinoceros species: *Rhinoceros unicornis* and *Dicerorhinus sumatrensis*.

Figure 4



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0 5 . 2 Use information in **Table 1** to give the **scientific** name of the taxon labelled **B** in **Figure 4**.

[1 mark]

_____

0 5 . 3 Draw an oval on **Figure 4** to show the species *Rhinoceros sondaicus*.

[1 mark]

Question 5 continues on the next page

Scientists investigated a phylogenetic relationship between individuals of five species of rhinoceros.

The scientists:

- determined the DNA base sequence of the *cyt b* gene of each rhinoceros
- compared each *cyt b* DNA base sequence with that of **one** Indian rhinoceros (called the reference rhinoceros)
- calculated the percentage difference between each *cyt b* DNA base sequence and that of the reference rhinoceros.

Table 2 shows their results.

Table 2

Investigated species of rhinoceros	**Percentage difference in DNA base sequences compared with the reference Indian rhinoceros**
Indian	2
Javan	5
Sumatran	13
White	14
Black	14

0 5 . 4 What can you conclude about the likely phylogenetic relationships between these species? Evaluate your conclusion.

[4 marks]

Do not write outside the box

0 5 . 5 A scientist obtained a rhinoceros horn confiscated from poachers and wanted to identify the species of rhinoceros that was killed for its horn.

He used the procedure described in Question **05.4** and calculated the difference in *cyt b* DNA as 14%.

What can you conclude from this result? Explain your answer.

Suggest a change to the procedure that will more precisely identify the rhinoceros species that provided the horn.

[2 marks]

Conclusion and explanation _____

_____

_____

_____

Suggested change to the procedure _____

_____

_____

_____

10

Turn over for the next question

0 6 . 1 A student dissected a sheep's heart. He prepared a risk assessment on:

- carrying a scalpel
- using a scalpel.

Complete **Table 3** by giving **three** control measures the student must use to reduce the risks associated with carrying **and** using a scalpel.

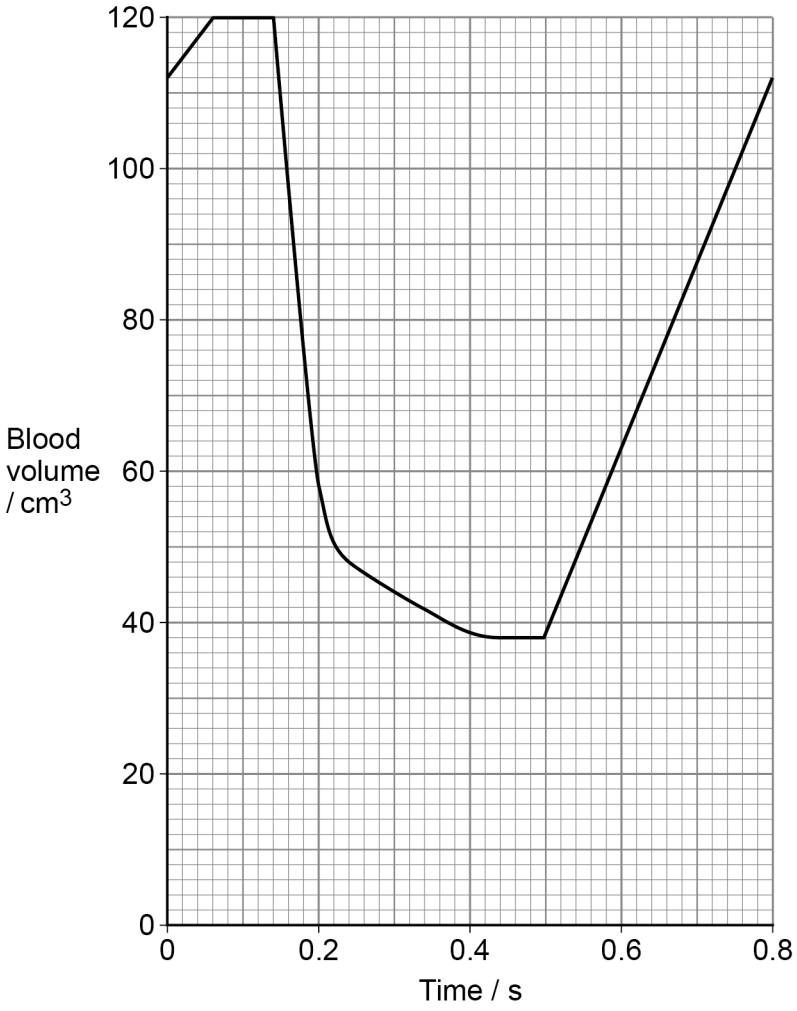
Table 3

Source	Hazard	Control measures to reduce risk
Sharp knife		1.
		2.
		3.

[2 marks]

0 6 . 2 A scientist measured the changes in blood volume inside the left ventricle of a mammalian heart during one heartbeat. **Figure 5** shows her results.

Figure 5



Use **Figure 5** to calculate the total volume of blood pumped from the left ventricle in 1 minute.

[2 marks]

Answer _____ cm^3

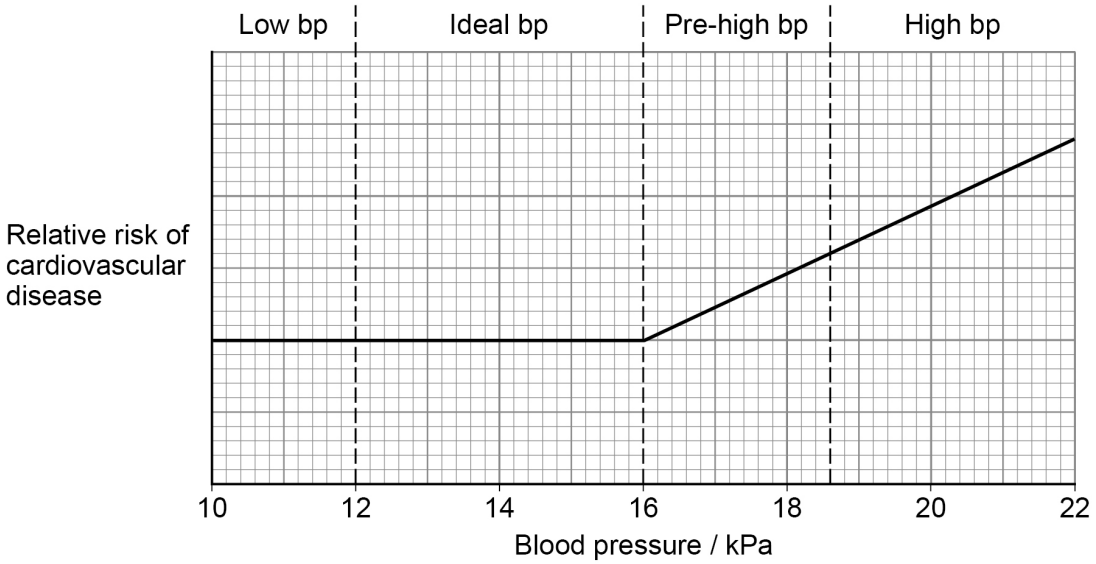
Turn over ►

Scientists investigated the correlation between patients' blood pressure (bp) and the risk of these patients developing cardiovascular disease.

They grouped the blood pressure measurements into four health categories: low, ideal, pre-high and high blood pressure.

Figure 6 shows the scientists' results.

Figure 6



In a separate investigation, a doctor measured the effect of blood pressure medicines on treating a large number of patients with a mean blood pressure of 22 kPa

The doctor used two different treatments.

- Treatment 1 contained one blood pressure medicine.
- Treatment 2 contained three blood pressure medicines.

He measured the change in the mean blood pressure after each treatment in these patients.

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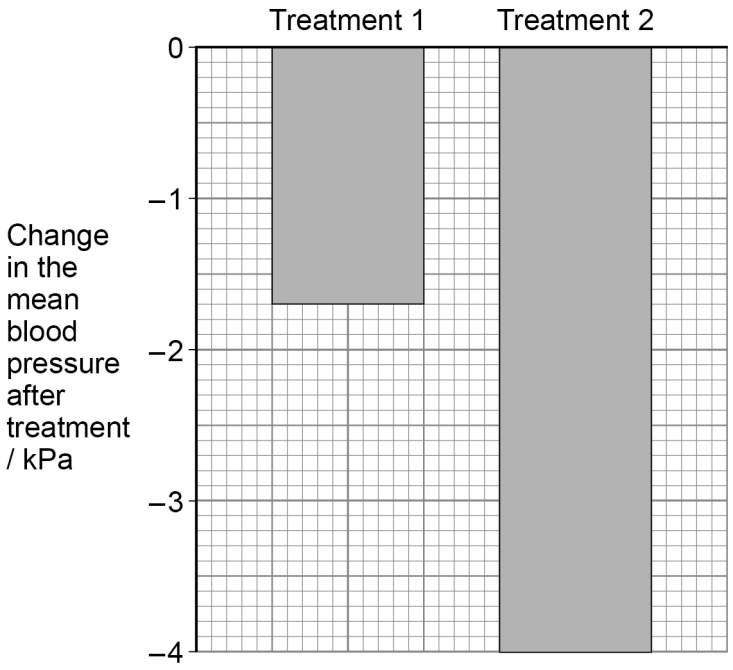
Figure 7 shows his results.

Figure 7



0 6 . 3 Using information in **Figure 6** and **Figure 7**, evaluate the effect of these treatments on reducing the risk of developing cardiovascular disease in patients with a mean blood pressure of 22 kPa

[4 marks]

8

Turn over ►

0 7 **Figure 8** is a photograph of a vertical section through a leaf observed using an optical microscope.

Figure 8

0 7 . 1 In the box below:

- produce a scientific drawing of the arrangement of tissues shown in **Figure 8**
- label **one** of the tissues in your drawing

Do **not** draw individual cells.

[3 marks]

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Question 7 continues on the next page

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ANSWER IN THE SPACES PROVIDED

Turn over ►

A scientist investigated factors that affect the shelf life of cut flowers.
A cut flower is the part of the stem with the flower bud attached after it has been cut from a plant.

The shelf life is the number of days the cut flowers are in good enough condition to be sold.

He:

- took 12 cut flowers from a rose plant
- determined the mean number of stomata per mm^2 on the leaves
- determined the transpiration rate for each cutting
- stored the cut flowers on a shelf in a brightly lit room
- determined the shelf life of the cut flowers.

Table 4 shows his results.

Table 4

Month cut flowers were obtained	**Mean number of stomata / mm^{-2} (± 2 SD)**	**Mean transpiration rate / cm^3 day^{-1} (± 2 SD)**	**Mean shelf life / days (± 2 SD)**
December	23 (± 2)	22 (± 3)	5 (± 1)
April	20 (± 3)	15 (± 2)	16 (± 2)

A value of ± 2 SD (standard deviations) from the mean includes over 95% of the data.

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0 7 . 2 Using information in **Table 4**, what can you conclude about the effect of different factors on the mean shelf life of cut flowers?

Explain your conclusions.

[4 marks]

0 7 . 3 Other than a change in temperature, give **one** change the scientist could make to the environmental conditions to increase the cut flowers' shelf life.

Explain your answer.

[3 marks]

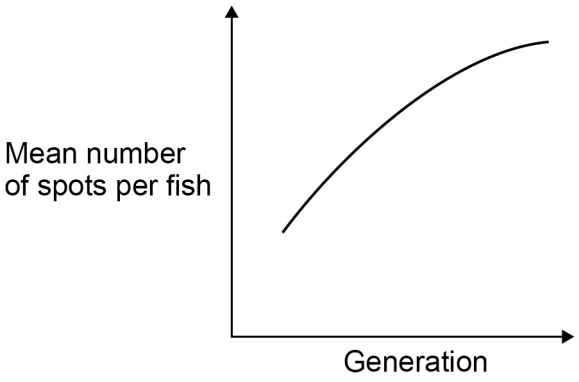
10

0 8 Guppies are small fish with brightly coloured spots on their body.
The number of spots on a guppy is controlled by genes.

A scientist investigated guppy breeding in a large population of guppies in a fish tank.
The fish tank contained brightly coloured stones. After each generation of breeding, she counted the number of spots on every guppy.

Figure 9 shows her results.

Figure 9



0 8 . 1 The scientist concluded that the mean number of spots on the guppies changed in this fish tank because the brightly coloured stones had affected the behaviour of the guppies.

The guppies did **not** behave aggressively towards each other and their feeding behaviour did **not** change.

Suggest **one** type of guppy behaviour that could be affected by the presence of brightly coloured stones.

[1 mark]

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0 8 . 2 Suggest:

- a further investigation the scientist could do to confirm that the brightly coloured stones had affected guppy behaviour
- a null hypothesis for the new investigation.

[2 marks]

Further investigation _____

_____

_____

_____

Null hypothesis _____

_____

_____

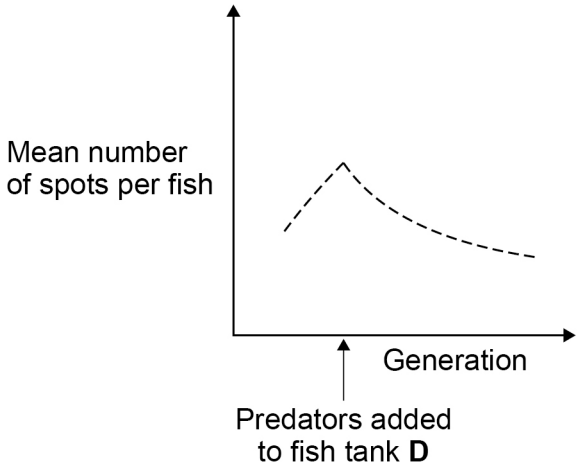
_____

Question 8 continues on the next page

0 8 . 3 The scientist repeated the investigation of guppy breeding in an identical fish tank, but added predators of the guppies into the fish tank at the fourth generation of breeding.

Figure 10 shows her results.

Figure 10



Name the type of selection the scientist investigated in this fish tank.

Explain why this selection affected the frequency of alleles in the population of guppies in this fish tank.

[4 marks]

Type of selection _____

_____

Explanation _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

7

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0 9 . 1 Describe how the structure of the insect gas exchange system:

- provides cells with sufficient oxygen
- limits water loss.

Explain your answers.

[5 marks]

Question 9 continues on the next page

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0 9 . 2 Describe how humans breathe in and out.

[5 marks]

10

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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