GCSE Combined Science

Biology Paper 2

Higher Tier

In addition to this paper you should have:
- A ruler.
- A calculator.

Centre name				
Centre number				
Candidate number				

Surname	
Other names	
Candidate signature	

Time allowed:
- 1 hour 15 minutes

Instructions to candidates
- Write your name and other details in the spaces provided above.
- Answer **all** questions in the spaces provided.
- Do all rough work on the paper.
- Cross out any work you do not want to be marked.

Information for candidates
- The marks available are given in brackets at the end of each question.
- There are 70 marks available for this paper.
- You are allowed to use a calculator.
- You should use good English and present your answers in a clear and organised way.
- For Questions 5.4 and 6.5 ensure that your answers have a clear and logical structure, include the right scientific terms, spelt correctly and include detailed, relevant information.

Advice to candidates
- In calculations show clearly how you worked out your answers.

For examiner's use

Q	Attempt Nº			Q	Attempt Nº		
	1	2	3		1	2	3
1				5			
2				6			
3				7			
4							
			Total				

Answer **all** questions in the spaces provided

1   Wing length in fruit flies is controlled by two alleles.

        Vestigial (short) wings are caused by the allele '**n**'.
        Normal length wings are caused by the allele '**N**'.

        The vestigial wing allele is recessive to the normal wing allele.

1.1   What does it mean if an allele is recessive?
        Tick **one** box.

        ☐   Two copies of the allele need to be present for the
            characteristic to be displayed.

        ☐   Only one copy of the allele needs to be present for the
            characteristic to be displayed.

        ☐   The allele only has a very small chance of being
            passed on to offspring.

                                                                        [1 mark]

1.2   Two fruit flies with normal length wings are crossed.
        Complete the Punnett square in **Figure 1** to show this cross.

                              Figure 1
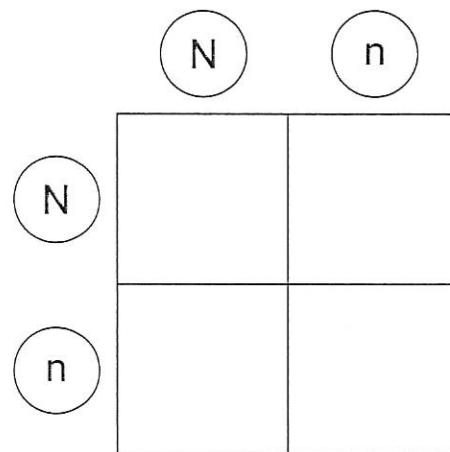
                                                                        [2 marks]

1.3   The two fruit flies crossed in **Figure 1** have 200 offspring.
        Calculate how many of the offspring would be expected to have vestigial wings.

                  Expected number of offspring with vestigial wings = ...
                                                                        [2 marks]

1.4 Fruit flies are eukaryotic organisms.
Describe how the genetic material of a fruit fly is stored in its cells.

....

....

....

....

[3 marks]

Turn over for the next question

Turn over ▶

2 Quadrats can be used to investigate the distribution of organisms in a habitat. A group of students used 1 m² quadrats to investigate the plant species that live in a small field next to their school.

They divided the field up into three sections, as shown in **Figure 2**.

Figure 2

Distance from the school (m)
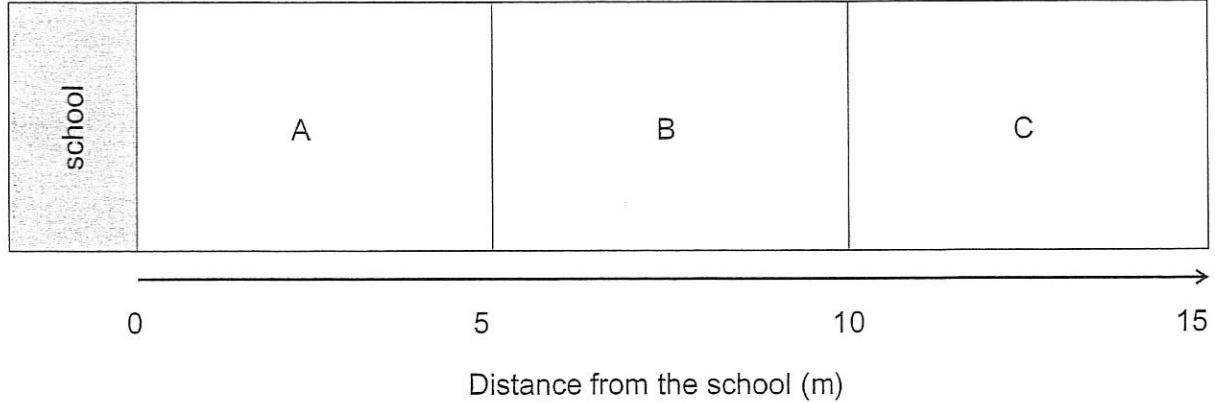
They placed three quadrats at random in each section of the field and counted the number of buttercups, clover and dandelions in each quadrat.
Their results are shown in **Table 1**.

Table 1

Plant	Section A				Section B				Section C			
	1	**2**	**3**	**Mean**	**1**	**2**	**3**	**Mean**	**1**	**2**	**3**	**Mean**
Buttercups	54	50	52	52	60	65	64	63	80	94	90	88
Clover	70	74	69	71	87	96	88		121	129	131	127
Dandelions	3	5	4	4	5	7	9	7	13	12	11	12

2.1 Explain why the quadrats were placed randomly.

....

....

[1 mark]

2.2 What is the median number of buttercups per m² in section **A**?

median number of buttercups per m² in section **A** = ...

[1 mark]

2.3 Calculate the mean number of clover per m² in section **B**.
Give your answer to 2 significant figures.

Mean number of clover per m² = ...

[2 marks]

2.4 Section **C** measures 5 m by 3 m.
Use the data in **Table 1** to estimate the total population of dandelions in section **C**.

Estimated total population of dandelions in section **C** = ...

[2 marks]

2.5 Use the data in **Table 1** to give a conclusion about the distribution of the three plant species across the field.

....

....

[1 mark]

Question 2 continues on the next page

Turn over ▶

2.6 Give **three** examples of abiotic factors that may affect the number of plants of each species growing at different locations in the field.

1. ....

2. ....

3. ....

[3 marks]

3   Students carried out an experiment to investigate the effect of age on reaction time. This is the method they used.

     1.   They recruited 35 volunteers with ages between 20 and 60.

     2.   The volunteers were asked to complete a task on a computer. In the task they had to press the enter key every time a certain shape appeared on the screen.

     3.   Each volunteer completed the task 10 times and the mean reaction rate for each volunteer was calculated.

     4.   The students then divided the volunteers' results into four age groups and calculated a mean reaction time for each group.

The results of the experiment are shown in **Table 2**.

Table 2

Age group	Number of volunteers	Mean reaction time (s)
20-29	12	0.30
30-39	5	0.31
40-49	12	0.35
50-60	6	0.39

The students' experiment tested a nervous response in the volunteers.

3.1   The effector in the response is a muscle in the hand.
Describe how muscles respond when they are stimulated by a nervous impulse.

....

[1 mark]

3.2   A motor neurone is involved in this nervous response.
Describe the role of motor neurones in the human body.

....

....

[2 marks]

3.3   Calculate the percentage increase in mean reaction time between the 20-29 age group and the 50-60 age group.

percentage increase = ... %

[2 marks]

Question 3 continues on the next page

Turn over ▶

3.4 Use data from **Table 2** to draw a bar chart on **Figure 3**, showing the mean reaction time for each age group.

- Complete the *y*-axis. Include a label and use a suitable scale.
- Plot the mean reaction time data.

Figure 3

Age of volunteers
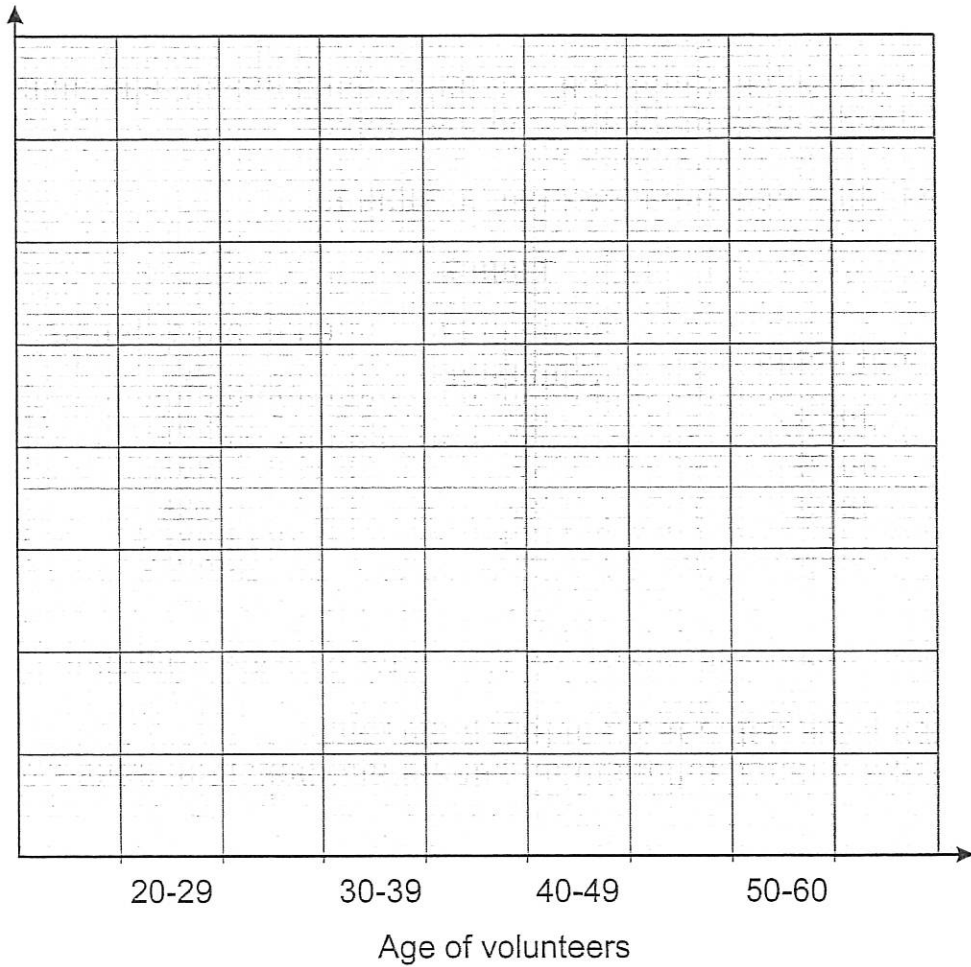
[2 marks]

From their results, the students concluded that as age increases, reaction time slows down.

3.5 Suggest **two** ways in which the students could have improved their method in order to have more confidence in their conclusion.

1. ....

....

2. ....

....

[2 marks]

4   A crop plant has been genetically modified to make it resistant to a particular herbicide. The GM crop plant contains a gene for herbicide resistance taken from another plant species.

4.1 Explain how genetic engineering would have been used to produce the GM crop plant.

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[3 marks]

The GM crop plant is already being grown by some farmers.

There are concerns that, as a result, wild grasses growing near to the crop plant might have also become more resistant to herbicides. Some scientists carried out an investigation to discover whether this had happened.

The scientists sprayed herbicide onto 100 grass plants in an area next to the GM crop, and onto 100 grass plants from a second area 2 km away from the GM crop.

Their results are shown in **Table 3**.

Table 3

Number of grass plants dying after spraying	
In area next to GM crop	In area 2 km away from GM crop
83	85

4.2 Explain the reason for testing a group of plants that had not been growing near the GM crop.

....

....

[2 marks]

Question 4 continues on the next page

Turn over ▶

4.3 Suggest **one** way in which the scientists could check if their results are reproducible.

....

....

[1 mark]

4.4 The scientists decided that there was no significant difference between the two groups of plants. Explain whether you agree or disagree with this conclusion.

....

....

[1 mark]

4.5 If the scientists are right in their conclusion, does this prove that the concerns about genes for resistance spreading are unfounded? Explain your answer.

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[2 marks]

10

5   Figure 4 shows a marine food web found near a hydrothermal vent.
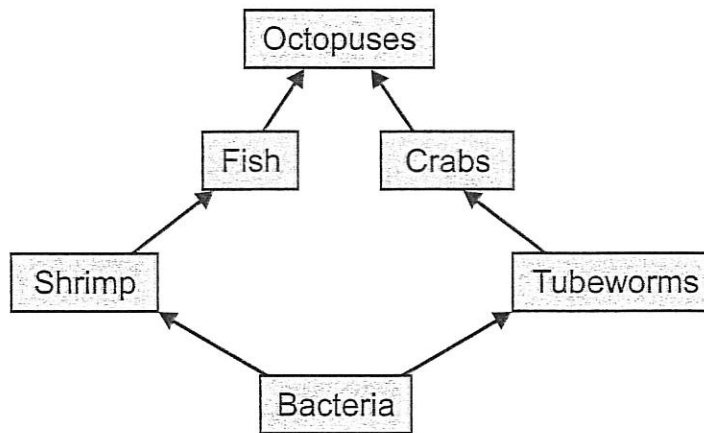
Figure 4

The producers in **Figure 4** are bacteria. They get the energy they need to increase their biomass from chemicals produced in the hydrothermal vent.

5.1   Compare these bacterial producers with typical plant producers.

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....

....

[2 marks]

The bacteria in **Figure 4** can survive at temperatures over 100 °C.

5.2   What name is given to microorganisms that can survive in extreme conditions?

....

[1 mark]

5.3   Suggest **one** way in which the bacteria in **Figure 4** will be adapted to survive in such high temperatures. Explain your answer.

....

....

....

[2 marks]

Question 5 continues on the next page

Turn over ▶

The organisms in the food web in **Figure 4** are all interdependent.

5.4 Explain how a fall in the population of **tubeworms** could affect the population sizes of the other organisms in **Figure 4**.

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[4 marks]

6 Stable communities are an important part of the natural environment.

6.1 What is meant by the term **stable community**?

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....

[1 mark]

Rabbits and foxes can live together in a stable community.

Figure 5 shows how the populations of rabbits and foxes in a stable community changed over time.
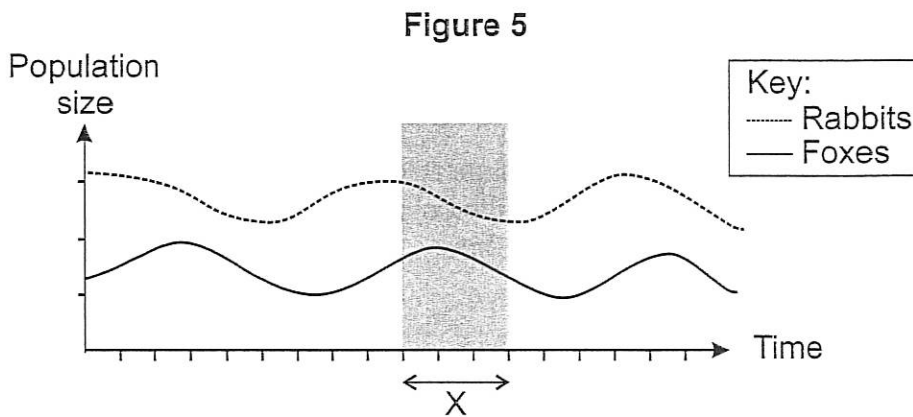
Figure 5

6.2 Explain the relationship between the population sizes of rabbits and foxes in the time period marked **X** on **Figure 5**.

....

....

....

....

....

[4 marks]

6.3 Apart from food, suggest **one** factor that the foxes in this community may be competing for.

....

[1 mark]

Question 6 continues on the next page

Turn over ▶

6.4 Communities are more likely to be stable if they have a high level of biodiversity. Explain **two** ways in which humans can maintain or increase biodiversity in an ecosystem.

1. ....

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....

2. ....

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[4 marks]

6.5 Grass needs both carbon dioxide and mineral ions to grow properly. When a lawn is cut, leaving the grass cuttings on the lawn may help to encourage a stable community. Explain how.

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[6 marks]

14

7   The human endocrine system is involved in the regulation of the blood glucose level.

For example, it controls the activity of the enzyme glycogen synthase.
Glycogen synthase helps to convert glucose into glycogen for storage.

7.1   Glycogen synthase is present in the liver.
Suggest **one** other location in the body where glycogen synthase is likely to
be present.

....
[1 mark]

7.2   Some people do not have enough functioning glycogen synthase in their liver.
When these people eat, their blood sugar level can become extremely high.
Suggest why.

....

....

....
[3 marks]

7.3   Suggest the name of a hormone that increases glycogen synthase activity.

....
[1 mark]

The human endocrine system also produces the hormone adrenaline.
Adrenaline is released if a person is in a frightening situation.

7.4   Explain why it is beneficial for the body to release adrenaline in a frightening situation.

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[4 marks]

END OF QUESTIONS