Materials
For this paper you must have:
- Ruler
- Pencil, Rubber, Protractor and Compass
- Scientific calculator, which you are expected to use when appropriate

Instructions
- Answer all questions
- Answer questions in the space provided
- All working must be shown
- Do all rough work in this book. Cross out any rough work you don't want to be marked

Information
- The marks for the questions are shown in brackets
Many organisms are adapted to avoid being eaten.

(a) The photograph shows a gecko on a leafy branch.

The gecko is adapted to avoid being eaten by predators.

Explain how.

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___________________________________________________________________
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(2)
(b) Ants can give a painful bite.

The photograph shows a type of ant living on acacia trees.

Acacia trees have thorns on their branches.

Branch of acacia tree.

(i) Predators are less likely to eat ants living on acacia trees than ants living on the ground.

Suggest why.

________________________________________________________________________

________________________________________________________________________

(ii) Giraffes eat the leaves of acacia trees.

Giraffes do **not** eat the leaves of acacia trees that have ants living on them.

Suggest why.

________________________________________________________________________

________________________________________________________________________

(1)
(c) The photographs show a wasp and a hoverfly.

The wasp and the hoverfly both have black and yellow stripes.

Wasp

Hoverfly

Wasps have stings, but hoverflies do not.

The stripes on the hoverfly help the hoverfly to avoid being eaten by predators.

Explain why.

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(2)

(Total 6 marks)

Some students were asked to investigate the distribution of clover in a field of grass. They noticed that the clover grew in patches amongst the grass.

(a) The students decided to use quadrats.

Describe how the students should decide where to place the quadrats to investigate the distribution of the clover.

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(2)
(b) The diagram shows one of the quadrats the students used.

(i) Estimate the number of squares of the quadrat covered with clover.

________________________________________________________________________

________________________________________________________________________

Number of squares = _______________

(1)

(ii) Describe how you worked out your answer to part (b)(i).

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(1)

(iii) Use your answer from part (b)(i) to calculate the percentage of the quadrat covered by the clover.

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________________________________________________________________________

________________________________________________________________________

Answer = _____________________________ %

(2)

(c) Suggest one factor that could account for the distribution of the clover plants.

________________________________________________________________________

(1)

(Total 7 marks)
The drawing shows a jerboa. Jerboas live in sandy deserts.

Jerboas sleep in underground holes during the hot day and come out during the cold night.

The jerboa’s main food is small insects which run across the surface of the sand.

For each question write the correct letter in the box.

Which structure, A, B, C, D, E or F:

(a) helps to insulate the jerboa

(b) helps the jerboa to detect insects on a dark night

(c) helps the jerboa to hop quickly to catch an insect

(d) helps the jerboa to keep its balance when hopping

(e) helps the jerboa to know the width of its underground hole in the dark?

(Total 5 marks)
Human activity affects ecosystems.

(a) Draw one line from each human activity to the effect on ecosystems.

<table>
<thead>
<tr>
<th>Human activity</th>
<th>Effect on ecosystems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in rice fields</td>
<td>Increases the amount of methane in the atmosphere</td>
</tr>
<tr>
<td>Destruction of peat bogs</td>
<td>Increases the amount of carbon dioxide that is released into the atmosphere</td>
</tr>
<tr>
<td></td>
<td>Reduces the rate at which carbon dioxide is locked up as wood</td>
</tr>
</tbody>
</table>

(b) (i) Deforestation also affects the atmosphere.

Give two reasons why deforestation takes place.

1. ____________________________________________________________
   ____________________________________________________________

2. ____________________________________________________________
   ____________________________________________________________

(ii) Changes in the gases in our atmosphere can cause global warming.

Give two possible effects of a rise in the Earth’s temperature.

1. ____________________________________________________________
   ____________________________________________________________

2. ____________________________________________________________
   ____________________________________________________________

(Total 6 marks)
The figure below shows the amount of forest cover on an island in Asia, in 1973 and in 2010.

(a) (i) Deforestation has decreased the amount of forest cover on the island.

Describe the change in the pattern of forest cover on the island.

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(ii) Give two possible reasons why the amount of forest has decreased between 1973 and 2010.

1. ____________________________________________________________________________

______________________________________________________________________________

2. ____________________________________________________________________________

______________________________________________________________________________
(b) Scientists are concerned about the effects of a decrease in forest cover on ecosystems.

Give two possible negative effects of the decrease in forest cover on ecosystems.

1. _________________________________________________________________
   _________________________________________________________________

2. _________________________________________________________________
   _________________________________________________________________

(Total 6 marks)

A grassy field on a farm measured 120 metres by 80 metres.

A student wanted to estimate the number of buttercup plants growing in the field.

The student found an area where buttercup plants were growing and placed a 1 m × 1 m quadrat in one position in that area.

**Figure 1** shows the buttercup plants in the quadrat.

![Figure 1](image)

The student said, 'This result shows that there are 115 200 buttercup plants in the field.'

(a) (i) How did the student calculate that there were 115 200 buttercup plants in the field?

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(2)
The student’s estimate of the number of buttercup plants in the field is probably not accurate. This is because the buttercup plants are not distributed evenly.

How would you improve the student’s method to give a more accurate estimate?

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______________________________________________________________
______________________________________________________________
______________________________________________________________

Sunlight is one environmental factor that might affect the distribution of the buttercup plants.

(i) Give three other environmental factors that might affect the distribution of the buttercup plants.

1. ____________________________________________________________

2. ____________________________________________________________

3. ____________________________________________________________

(ii) Explain how the amount of sunlight could affect the distribution of the buttercup plants.
Every year, the farmer puts fertiliser containing mineral ions on some of his fields. When there is a lot of rain, some of the fertiliser is washed into the river.

(i) When fertiliser goes into the river, the concentration of oxygen dissolved in the water decreases.

Explain why the concentration of oxygen decreases.

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(ii) There is a city 4 km downstream from the farm.

Apart from fertiliser, give one other form of pollution that might go into the river as it flows through the city.
(d) Three sites, A, B and C, are shown in Figure 2.

Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

Figure 3 shows the scientists’ results.

(i) How many more species of mayfly were there at Site B than at Site A?

______________________________________________________________

(ii) Suggest what caused this increase in the number of species of mayfly.

______________________________________________________________

______________________________________________________________

(iii) The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from Figure 3 to suggest why.

(Total 19 marks)
In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The diagram shows part of the carbon cycle.
Describe how living things are involved in the constant cycling of carbon.

Organisms have adaptations that enable them to survive in extreme conditions.

(a) The photograph shows an arctic fox.

By Algkalv (Own work) [CC-BY-3.0], via Wikimedia Commons
This fox lives in the Arctic, where it is very cold.

Suggest two ways in which the arctic fox is adapted for life in very cold conditions.

Explain how each adaptation helps the arctic fox to survive in very cold conditions.

Adaptation 1
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
How this adaptation helps the arctic fox to survive in very cold conditions.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Adaptation 2
___________________________________________________________________
___________________________________________________________________
How this adaptation helps the arctic fox to survive in very cold conditions.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(b) The photograph shows an antelope that lives in a sandy desert.
The antelope is prey to large cats such as cheetahs.

Suggest one adaptation that helps this antelope avoid being killed by predators.

Explain how this adaptation helps the antelope avoid being killed by predators.

Adaptation __________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

How this adaptation helps the antelope avoid being killed by predators.
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___________________________________________________________________
___________________________________________________________________

(2)
(Total 6 marks)

At the seashore, the tide comes in and goes out twice each day.

Some students investigated whether two different species of seaweed could live only at certain positions on a rocky shore.

Seaweeds are plant-like organisms that make their food by photosynthesis.

**Figure 1** shows the two species of seaweed that the students investigated.

**Figure 1**

<table>
<thead>
<tr>
<th>Bladder wrack</th>
<th>Sea lettuce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air bladders</td>
<td></td>
</tr>
<tr>
<td>Holdfast</td>
<td>(fixes seaweed to the rock)</td>
</tr>
</tbody>
</table>

Not to scale
(a) The students:

1. placed a 50-metre tape measure on the rocks at right angles to the sea
2. placed a quadrat next to the tape measure
3. recorded whether each species was present or not.

The students repeated steps 2 and 3 every metre down the shore.

**Figure 2** shows a section of the seashore and the students’ results.

![Figure 2: Section of the seashore](image)

(i) The students placed the quadrat at regular intervals along a transect line rather than placing the quadrat at random positions anywhere on the rocky shore.

Explain why.

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(2)
(ii) How could the students have improved their investigation to ensure that they produced valid data?

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(2)

(iii) Figure 2 is repeated here to help you answer this question.

**Figure 2**

*Section of the seashore*

![Figure 2](image-url)

**Students’ results**

<table>
<thead>
<tr>
<th></th>
<th>Bladder wrack</th>
<th>Sea lettuce</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>10 - 20</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>20 - 30</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>30 - 40</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

The students concluded that bladder wrack is better adapted than sea lettuce to survive in dry conditions.

What is the evidence for this conclusion?

Use information from **Figure 2**.
(b) The bladder wrack has many air bladders. The air bladders help the bladder wrack to float upwards when the sea covers it.

Suggest how this helps the bladder wrack to survive.

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___________________________________________________________________
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(2)

(Total 8 marks)

The drawings show two different species of butterfly.

![Amauris](image1.png) ![Hypolimnas](image2.png)

- Both species can be eaten by most birds.
- *Amauris* has an unpleasant taste which birds do **not** like, so birds have learned **not** to prey on it.
- *Hypolimnas* does **not** have an unpleasant taste but most birds do **not** prey on it.

(a) Suggest why most birds do **not** prey on *Hypolimnas*.

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(2)
(b) Suggest an explanation, in terms of natural selection, for the markings on the wings of *Hypolimnas*.

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(3) (Total 5 marks)