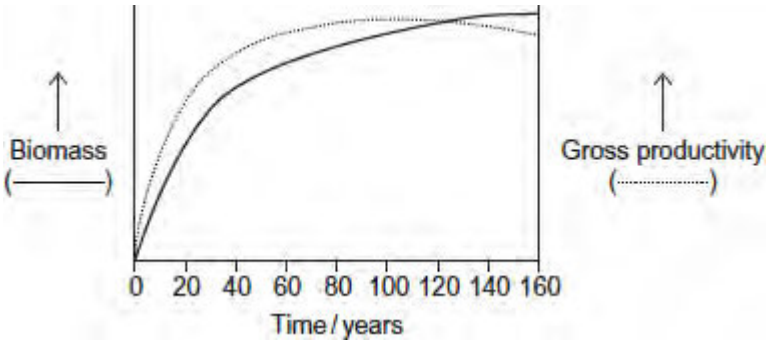
Q1. The graph shows how gross productivity and biomass in an area changed with time in the succession from bare soil to mature woodland.



(a) (i) Suggest appropriate units for gross productivity.

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(1)

(ii) Explain the decrease in gross productivity as the woodland matures.

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(2)

(b) Use your knowledge of succession to explain the increase in biomass during the first 20 years.

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[Extra space] .....

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(3)

(c) Use the information in the graph and your knowledge of net productivity to explain why biomass shows little increase after 100 years.

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(2)

(d) Suggest **one** reason for conserving woodlands.

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(1)
(Total 9 marks)

Q2.(a) On islands in the Caribbean, there are almost 150 species of lizards belonging to the genus *Anolis*. Scientists believe that these species evolved from two species found on mainland USA. Explain how the Caribbean species could have evolved.

(6)

(b) *Anolis sagrei* is a species of lizard that is found on some of the smallest Caribbean islands. Describe how you could use the mark-release-recapture method to estimate

the number of *Anolis sagrei* on one of these islands.

(4)

(c) Large areas of tropical forest are still found on some Caribbean islands. The concentration of carbon dioxide in the air of these forests changes over a period of 24 hours and at different heights above ground.

Use your knowledge of photosynthesis and respiration to describe and explain how the concentration of carbon dioxide in the air changes:

- over a period of 24 hours
- at different heights above ground.

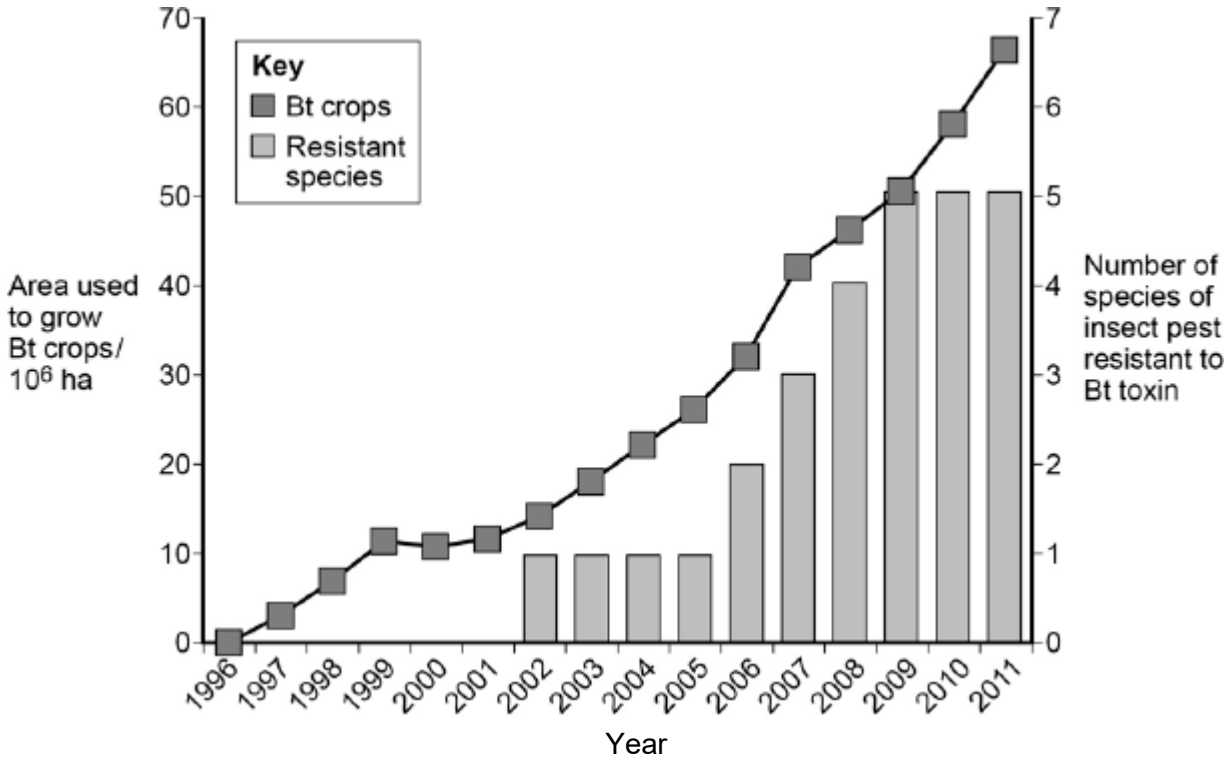
(5)
(Total 15 marks)

Q3. To reduce the damage caused by insect pests, some farmers spray their fields of crop plants with pesticide. Many of these pesticides have been shown to cause environmental damage.

Bt plants have been genetically modified to produce a toxin that kills insect pests. The use of Bt crop plants has led to a reduction in the use of pesticides.

Scientists have found that some species of insect pest have become resistant to the toxin produced by the Bt crop plants.

The figure below shows information about the use of Bt crops and the number of species of insect pest resistant to the Bt toxin in one country.



(a) Can you conclude that the insect pest resistant to Bt toxin found in the years 2002 to 2005 was the same insect species? Explain your answer.

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(1)

(b) One farmer stated that the increase in the use of Bt crop plants had caused a mutation in one of the insect species and that this mutation had spread to other species of insect. Was he correct? Explain your answer.

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(Extra space) .....

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(4)

(c) There was a time lag between the introduction of Bt crops and the appearance of the first insect species that was resistant to the Bt toxin.
Explain why there was a time lag.

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(3)
(Total 8 marks)

Q4. Ecologists used a method called proportional sampling to estimate the population size of an animal species. This method is based on assumptions. Two of the assumptions are given below.

1. They know the size of the area, **A**, where the animal population lives.
2. The animals are uniformly distributed in this area.

To carry out the method, the ecologists:

- chose a region of known size, **R**, inside area **A**
- counted the number of animals in region **R**. They called this number **S**
- assumed that the number, **S**, would be in proportion to the size of the total population, **P**, in area **A**.

(a) Proportional sampling can be used to estimate the population size of a species that is uniformly distributed.

(i) What is a **species**?

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(1)

(ii) What is meant by **uniformly distributed**?

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(1)

(b) Use the letters **A**, **R** and **S** to write an equation showing how proportional sampling is used to estimate the total size of a population, **P**. Show your working.

P = ...

(2)

(c) Population size can be estimated using proportional sampling or mark-release-recapture.

(i) How do the assumptions made in proportional sampling differ from those made in mark-release-recapture?

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(2)

(ii) Give **one** assumption about the animals caught that is made in both methods.

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(1)
(Total 7 marks)