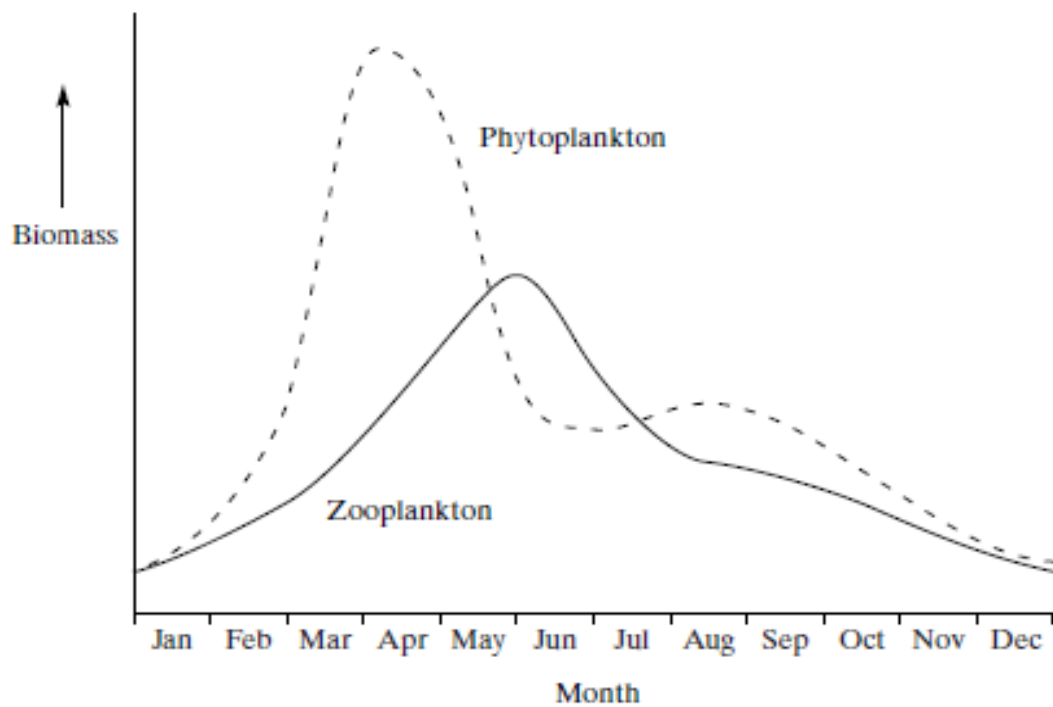


15.

Phytoplankton are microscopic photosynthesising organisms which live in water. In favourable environmental conditions they have a very high rate of reproduction. They are eaten by microscopic animals called zooplankton. In an investigation, samples of water were removed from a lake at intervals over a twelve-month period and the biomasses of these organisms were determined. The results are shown in the graph.



The diagram shows the relationship between the biomass of the phytoplankton and the biomass of the zooplankton for one of the months during this investigation.



(a) Use the graph to give **one** month in which this relationship would have been found.

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- (b) Explain why the biomass of the primary consumers is less than the biomass of the producers in most communities.

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(3 marks)

- (c) Explain why the biomass of the phytoplankton in the lake could be less than that of the zooplankton, as shown in the diagram.

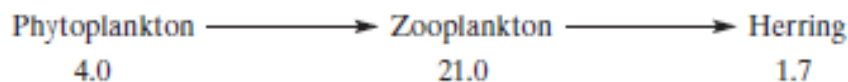
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(1 mark)

16.

The herring is a fish found in the North Sea. In the food chain below, the figures represent biomass. The units are g m^{-3} .



- (a) Sketch and label a pyramid of biomass to represent this food chain.

(1 mark)

- (b) In this food chain, the phytoplankton reproduce very rapidly. Suggest why this rapid rate of reproduction is essential to sustain the food chain.

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(2 marks)

- (c) Phytoplankton are mainly unicellular Protocista. Give **two** structural features you would expect to find in phytoplankton cells.

Feature 1

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Feature 2

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(2 marks)

17.

In the activated sludge method of sewage treatment, organic matter in untreated sewage supplies nutrients to bacteria in the treatment tank. These bacteria include decomposers and nitrifying bacteria. The bacteria are eaten by ciliated protoctists, which are, in turn, eaten by carnivorous protoctists.

- (a) (i) Sketch and label a pyramid of energy for the organisms found in the treatment tank.

(1 mark)

- (ii) Explain what causes this pyramid of energy to be this shape.

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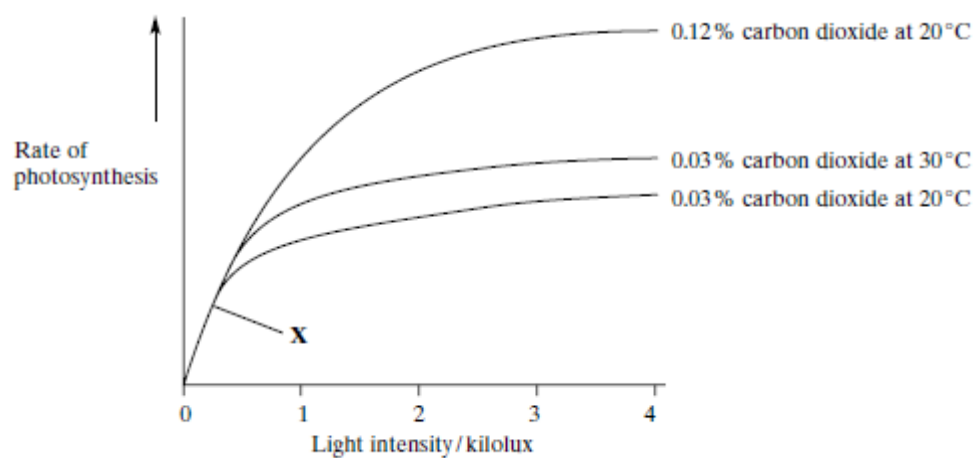
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(2 marks)

18.

The graph shows the effect of carbon dioxide concentration, light intensity and temperature on the rate of photosynthesis of a crop plant.



- (a) Which factor is limiting the rate of photosynthesis at point X? Explain your answer.

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(1 mark)

- (b) In a glasshouse in winter, the mean carbon dioxide concentration is 0.03 %, the temperature is 20°C and the light intensity is 3 kilolux.

Using the graph, predict whether increasing the carbon dioxide concentration to 0.12 % or the temperature to 30°C would result in the greater increase in growth. Using your knowledge of photosynthesis, give an explanation for your answer.

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(2 marks)

- (c) Explain why it is not advisable to increase the temperature in a glasshouse on a dull winter day.

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(2 marks)

- (d) Little of the sunlight falling on the leaves of a plant grown in a glasshouse, even under optimum conditions, is used in photosynthesis. Give **two** explanations.

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(2 marks)

19.

- (a) (i) What is meant by *biological control*?

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 (1 mark)

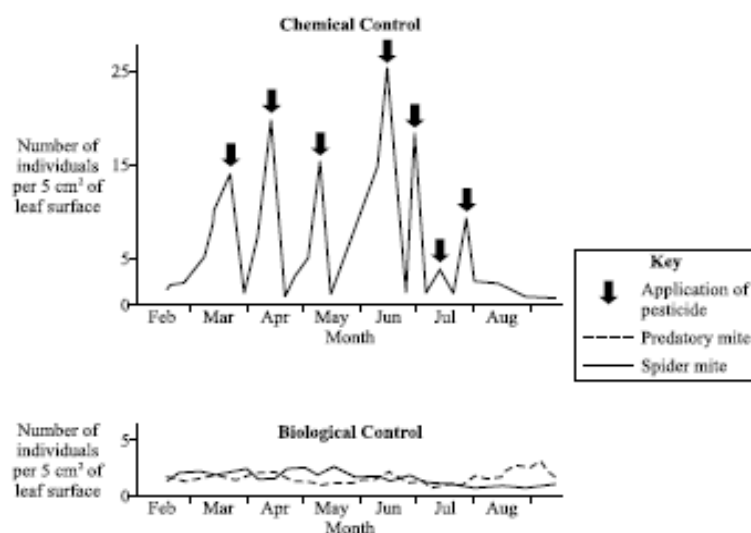
- (ii) Give **two** characteristics of a successful biological control agent.

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 (2 marks)

Spider mites are pests which cause damage to cucumbers that are grown in glasshouses. The graphs show the results of an investigation into different ways of controlling spider mites. In one glasshouse, spider mites were treated with pesticides. In another glasshouse, a predatory mite was used as a biological control agent.



- (b) Which method of controlling spider mites was more effective? Give evidence from the graphs to support your answer.

Method:

Evidence:

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 (2 marks)

- (c) Neither method gets rid of the spider mites completely. Explain the reason for this for:

- (i) chemical control;

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- (ii) biological control.....

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 (3 marks)

20.

The adult whitefly and its larva feed on the leaves of crop plants. A parasitic wasp lays its eggs inside the whitefly larva. When the wasp larvae hatch, they feed on the internal organs of the whitefly larva. The wasp can be released into glasshouses to act as a biological control for the whitefly.

- (a) How would the whitefly reduce the yield of a crop plant?

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(2 marks)

- (b) (i) Give **two** reasons why biological control might be better than the use of chemical pesticides for controlling whitefly.

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(2 marks)

- (ii) Give **two** reasons why the use of chemical pesticides might be better than biological control of the whitefly.

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(2 marks)

21.

Purple loosestrife is a plant which grows in Europe. It was introduced into the USA where it became a pest.

- (a) Suggest why purple loosestrife became a pest when it was introduced into the USA, but is not a pest in Europe.

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(2 marks)

- (b) A European beetle was tested to see whether it could be used for the biological control of purple loosestrife in the USA. In an investigation, beetles were released in an area where purple loosestrife was a pest. The table shows some of the results.

| Time after releasing beetles / years | Mean number of purple loosestrife stems per square metre | Mean number of beetles per square metre |
|--------------------------------------|--|---|
| 1 | 22 | 5 |
| 2 | 8 | 40 |
| 3 | 6 | 68 |
| 4 | 7 | 62 |

Are the beetles effective in controlling purple loosestrife? Give evidence from the table to support your answer.

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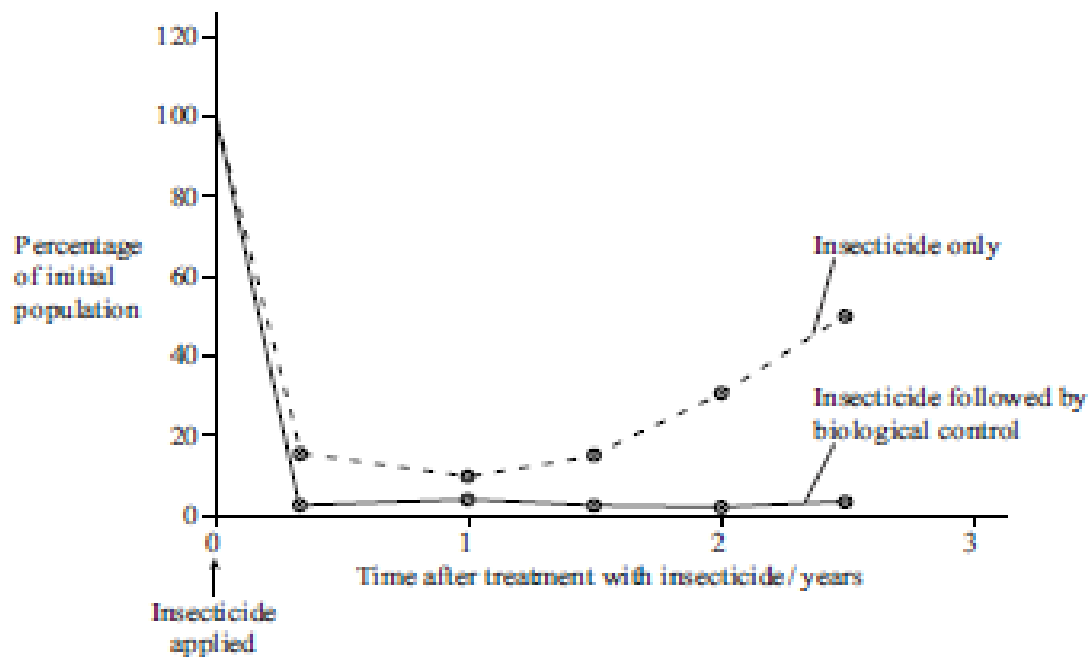
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(2 marks)

- (c) Fire-ants are a serious pest in parts of the USA. An investigation was carried out to find the best way to control the fire-ant population. The graph shows the results of this investigation.



- (i) Describe the effect of using insecticide followed by biological control.

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(2 marks)

- (ii) Explain the change in fire-ant population over the period when they were treated with an insecticide alone.

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(3 marks)

(d) Give the advantages and disadvantages of using biological control.

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(6 marks)

Over many years, the water flowing into a lake contained low concentrations of a pesticide. This led to very high concentrations of the pesticide in some species of fish.

- (3 marks)

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- (1 mark)

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- (2 marks)

- (4 marks)

23.

Read the following passage.

Malaria is a disease which kills over two million people every year. It is caused by a microorganism that lives in the blood. This microorganism is spread from people with malaria to uninfected people by mosquitoes.

A common fungus could become a valuable weapon in the fight against malaria. It kills the mosquitoes that carry the malaria-causing microorganism. As a result of a laboratory investigation, scientists have found that spraying with the fungus could help to prevent the spread of malaria. 5

A second investigation was then carried out. Fungal spores were sprayed on walls of houses. Scientists found that, when a mosquito came into contact with the spores, the spores germinated and the fungus grew slowly in the body of the mosquito. The mosquito then died. 10

The use of the fungus in killing mosquitoes was an important discovery because many mosquitoes have developed resistance to chemical insecticides. Those insecticides that are still effective, such as DDT, are now banned because they can accumulate in food chains. 15

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Use information from the passage and your own knowledge to answer the following questions.

- (a) (i) What is meant by biological control ?

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(2 marks)

- (ii) Describe the advantages and disadvantages of using biological control to kill mosquitoes that transmit malaria.

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(6 marks)

- (b) Explain why scientists carried out the second investigation (line 8).

(2 marks)

- (c) Explain how insecticides such as DDT accumulate in food chains (lines 14–15).

(3 marks)

- (d) Scientists suggested that, as a result of these investigations, the fungus could be used to control mosquitoes. They thought that it would be necessary to use an insecticide as well as the fungus for the first few weeks.

Explain why it would be necessary to use an insecticide as well as the fungus for the first few weeks.

(2 marks)

24.

In an attempt to control the huge numbers of an insect pest, low doses of a pesticide were sprayed on a lake. After spraying, the concentration of pesticide in the lake water was 14 parts per billion. After spraying, diving birds which fed on small fish in the lake were found to be dying. The concentration of the pesticide in these birds was more than 1 part per thousand.

- (a) Explain why the pesticide was in such a high concentration in the diving birds.

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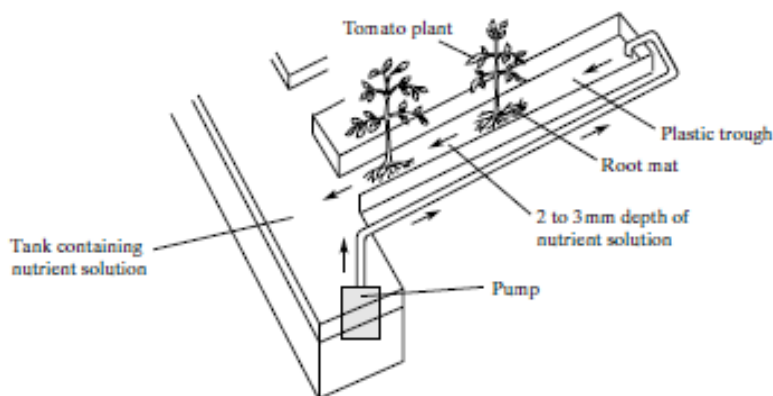
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(3 marks)

25.

Tomato growers have increased the yield of fruit from 100 to 400 tonnes per hectare by growing the tomato plants in automatically heated glasshouses and enhancing the carbon dioxide concentration. To control the nutrient supply to the roots, the plants are grown without soil in plastic troughs, as shown in the diagram.



- (a) Explain how enhancing the carbon dioxide concentration helps to increase the yield.

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(2 marks)

- (b) Maintaining a high temperature in a glasshouse in winter, when the light intensity is low, may reduce the yield. Explain how.

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(2 marks)

- (c) Tomato fruits have a high percentage of water. When making tomato ketchup, it is more economical to use fruits which have a low percentage of water. Growers can reduce the water content of the fruit by adding sodium chloride to the nutrient solution in the plastic trough.

Explain how adding sodium chloride can reduce the water content of the fruit.

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(2 marks)

26.

A popular lake in the United States was affected by large swarms of midges (small biting insects) in the summer. The lake was sprayed with insecticide to kill the midges. The effect of spraying on the following food chain in the lake was investigated.

Plant plankton \longrightarrow sunfish \longrightarrow western grebe

- (a) Shortly after spraying the concentration of insecticide in the water of the lake was $2 \times 10^{-5} \text{ g dm}^{-3}$. After four weeks the concentration in the plant plankton was equivalent to $5 \times 10^{-3} \text{ g dm}^{-3}$.

By how many times was the insecticide concentrated?

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(1 mark)

- (b) After a few months the concentration of insecticide in the grebes was more than six times the concentration in the sunfish. Explain why.

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(2 marks)

27.

- (a) Describe **two** problems caused by the use of non-specific insecticides.

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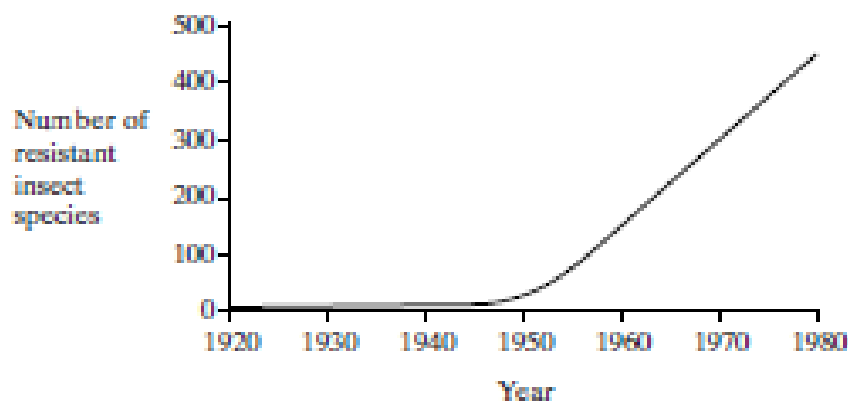
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(2 marks)

- (b) The graph shows the number of species of insects reported to be resistant to at least one insecticide between 1920 and 1980.



- (i) Suggest **one** reason why there was a rapid rise in resistant species after 1950.

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(1 mark)

- 8 (ii) Explain how an insect population can become resistant to an insecticide.

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(3 marks)

28.

- (a) Growing the same crop over a large area year after year is known as monoculture. Explain why an outbreak of pests is more of a problem in monoculture than where a mixture of crops is grown.

(3 marks)

- (b) S (i) Insect pests have developed resistance to pesticides. If the resistance is due to a single gene, explain how resistant insects could be produced when both parents are susceptible to the pesticide.

(3 marks)

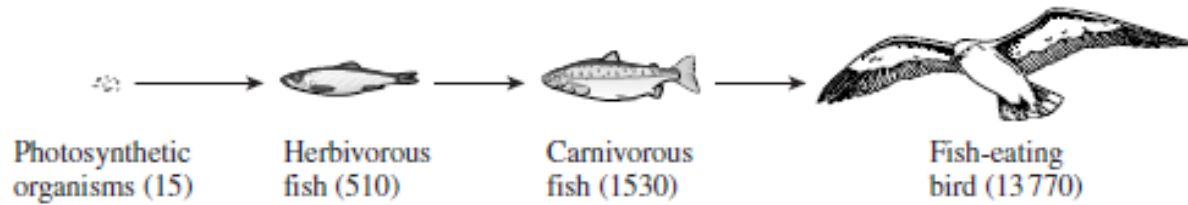
- (ii) Other than resistance, give ~~two~~ disadvantages of using pesticides.

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(2 marks)

DDT is a pesticide. It used to be sprayed on crops to kill insects. Runoff from fields could carry DDT into lakes and rivers. The diagram shows a food chain after DDT had been in use for many years. The numbers in brackets are the concentrations of DDT in the tissues of the organisms. The units are parts per million.



- (a) Fish-eating birds died from DDT poisoning. Explain why.

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(2 marks)

- S (b) Many insect populations became resistant to DDT. Explain how.

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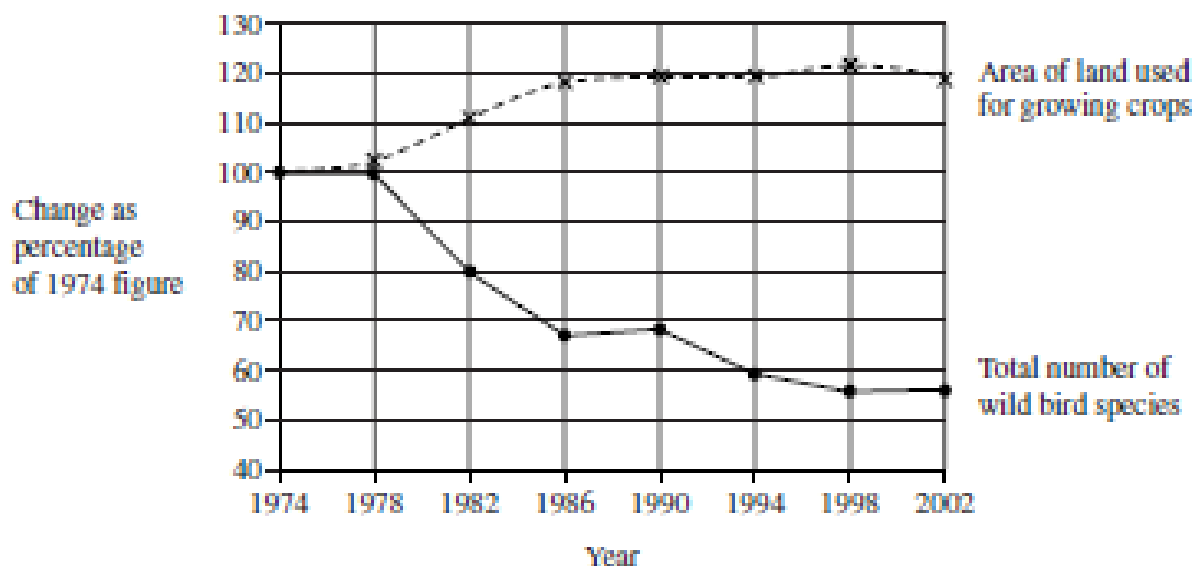
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(4 marks)

30.

- Many farmers are now managing their land to balance the need for increased food production and conservation of the environment. Changes in the populations of some bird species are used to monitor changes in the environment. The graph shows the change in the number of wild bird species found on farmland in the UK and in the area of land used for growing crops between 1974 and 2002.



- (a) Modern farming practices might have been responsible for the changes in the number of wild bird species between 1974 and 2002. Explain how.

(4 marks)