Q1. Farmland previously used for growing crops was left for 30 years and developed into woodland. During this period, ecologists recorded an increase in the diversity of birds in the area.

(a) Name the process that resulted in the development of woodland from farmland.

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(1)

(b) Explain the increase in the diversity of birds as the woodland developed.

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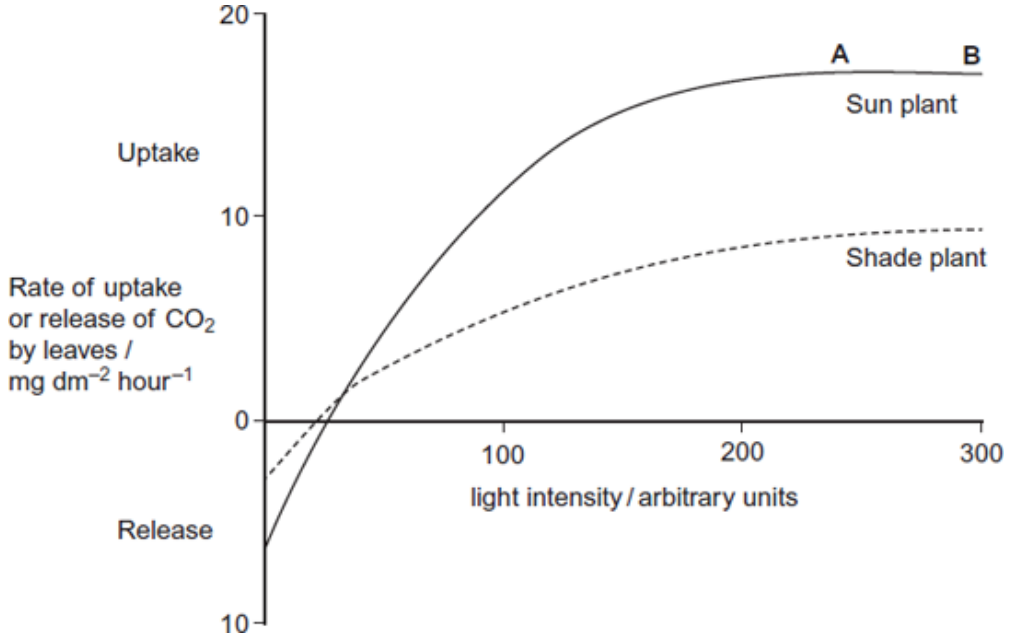
(3)

(c) The ecologists also investigated photosynthesis in two species of plant found in the woodland. One of the species was adapted to growing in bright sunlight (sun plant) and the other was adapted to growing in the shade (shade plant). The ecologists' results are shown in the figure below.



(i) Give **two** factors which could be limiting the rate of photosynthesis in the sun plant between points **A** and **B** on the figure.

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2.....

(1)

(ii) Explain why CO_2 uptake is a measure of net productivity.

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(1)

(iii) Use the information in the figure to explain how the shade plant is better adapted than the sun plant to growing at low light intensities.

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(2)
(Total 8 marks)

Q2. The photograph shows marram grass growing on a sand dune.

Marram grass on sand dune by Nigel Chadwick [CC-BY-SA], via Wikimedia Commons

(a) Describe how you would investigate the distribution of marram grass from one side of the dune to the other.

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(3)

(b) Marram grass is a pioneer species that grows on sand dunes. It has long roots and a vertically growing stem that grows up through the sand.
Sand dunes are easily damaged by visitors and are blown by the wind. Planting marram grass is useful in helping sand dune ecosystems to recover from damage.

Use your knowledge of succession to explain how.

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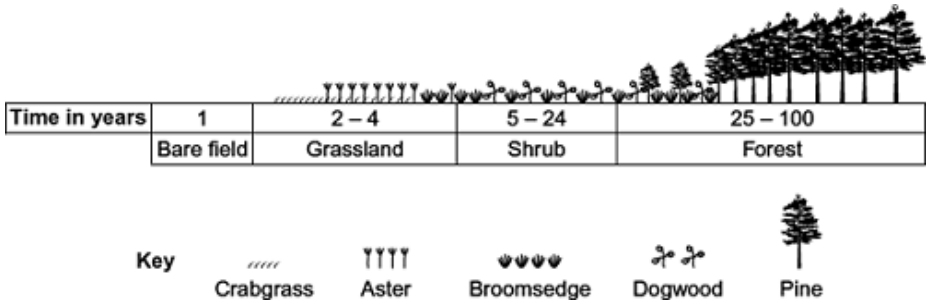
(2)
(Total 5 marks)

Q3. The diagram shows the dominant plants in communities formed during a succession from bare soil to pine forest.



(a) Name the pioneer species shown in the diagram.

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(1)

(b) The species that are present change during succession. Explain why.

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(2)

(c) The pine trees in the forest have leaves all year. Explain how this results in a low species diversity of plants in the forest.

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(1)

(Total 4 marks)

Q4. Biologists studied the process of succession in an area of wasteland over a period of ten years. They calculated the index of diversity of the area every year. After three years, the index of diversity was 1.6. After ten years, it had risen to 4.3.

(a) What information concerning the organisms present in the area is suggested by the increase in the index of diversity?

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(2)

(b) The increase in the index of diversity is one indication that a biological succession is taking place in the area. Describe those features of a succession that would bring about an increase in the index of diversity.

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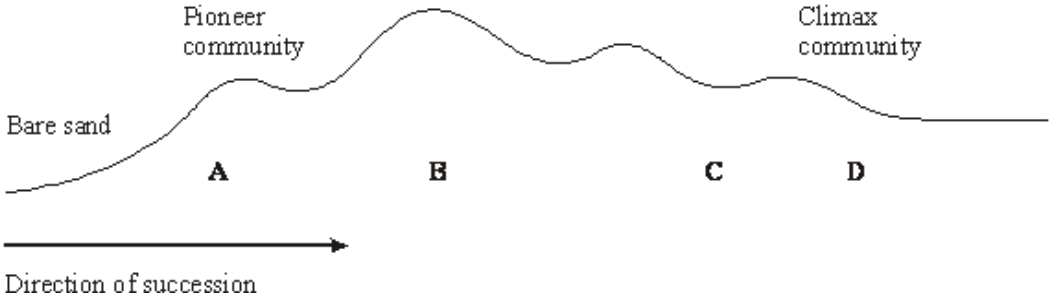
(3)

(Total 5 marks)

Q5. In a sand dune succession the pioneer community (**A**) colonises bare sand. This community is replaced over time by other communities (**B** and **C**) until a climax community of woodland (**D**) is formed.



(a) The communities **A** to **D** are composed of different species. Explain how the change in species composition occurs in a succession.

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(3)

(b) Which community, **A** to **D**, is the most stable? Explain what makes this the most stable community.

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(2)

S (c) Many species in the pioneer community are xerophytes. Suggest and explain how having sunken stomata is an advantage to these plants.

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(3)

(d) Explain why it would be more appropriate to use a transect rather than random quadrats when investigating this succession.

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(1)

(Total 9 marks)

Q6. Glaciers are masses of moving ice. When glaciers shrink, the thick covering of ice gradually disappears to leave behind bare land. Land exposed by a shrinking glacier in Alaska became covered by dense forest in 150 years.

(a) Explain how succession resulted in the formation of the forest.

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(4)

(b) In areas of poor drainage the soil is waterlogged. In these areas the climax community is bog dominated by the moss, *Sphagnum*. Explain why bog is described as the climax community.

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(1)

(c) Waterlogged soils lack oxygen. Suggest why trees are unable to survive in waterlogged soils.

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(2)

(d) The water and soil in *Sphagnum* bogs are usually acidic. Suggest why *Sphagnum* is not fully decomposed after it dies.

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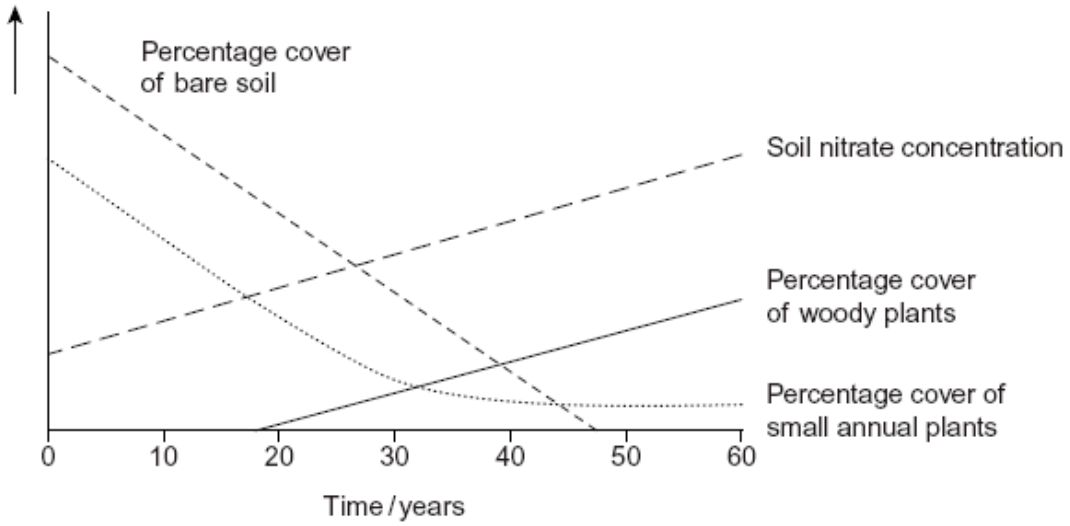
(3)
(Total 10 marks)

Q7. Ecologists investigated succession in some abandoned crop fields. The data that they collected are shown in the graph. The curves show the trends that occurred over a period of 60 years.



(a) Explain the change in soil nitrate concentration shown on the graph.

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(2)

(b) The pioneer plants had different characteristics from the plants that colonised the fields after 50 years.

(i) The pioneer plants had seeds that germinate better when the temperature fluctuates.

Explain the advantage of this to these pioneer plants.

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(2)

(ii) Explain the advantage to a plant that colonises after 50 years of having a high rate of photosynthesis at low light intensities.

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(1)

(c) Conservation of grassland habitats involves management of succession. Use the data in the graph to explain why.

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(Total 7 marks)

Q8. When coal is mined by open-cast mining, the top layer of soil is first scraped off and stored in a large heap. Once mining has finished, the area can be reclaimed. Soil from this store is then spread back over the surface.

Some of the bacteria living in the soil store respire aerobically and some respire anaerobically. **Table 1** shows the numbers of aerobic and anaerobic bacteria found at different depths in a soil store.

Depth / cm	Mean number of bacteria per gram of soil ($\times 10^7$)			
	Aerobic bacteria		Anaerobic bacteria	
	after 1 month	after 6 months	after 1 month	after 6 months
0	12.0	12.1	0.6	0.8
50	10.4	8.6	0.8	1.3
100	10.1	6.1	0.7	4.1
150	10.0	3.2	0.7	7.9
200	11.6	0.8	0.7	8.4
250	11.9	0.7	0.8	8.8
300	11.0	0.8	0.6	9.1

Table 1

(a) Some of the soil used to determine bacterial numbers was collected from the surface of the soil store. Describe how you would ensure that this soil was collected at random.

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(2)

(b) (i) Describe how the numbers of aerobic bacteria after 6 months change with depth.

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(2)

(ii) Explain the difference in the numbers of aerobic bacteria at a depth of 300 cm between 1 and 6 months.

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(c) Explain how the changes in bacterial numbers which take place at 150 cm illustrate the process of succession.

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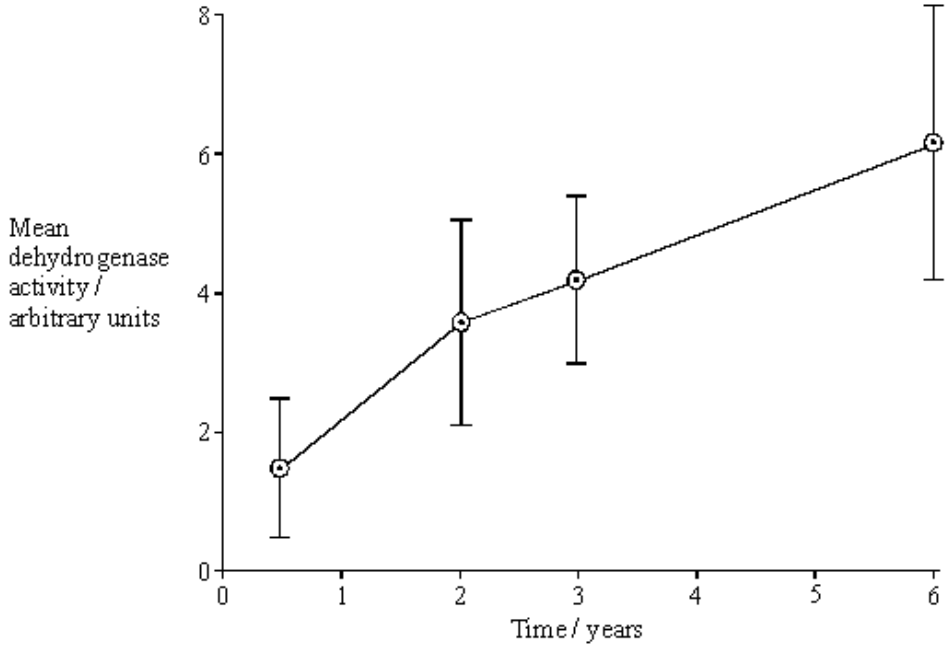
(3)

Dehydrogenase is an enzyme involved in aerobic respiration. Dehydrogenase activity in a soil sample can be used as a measure of the activity of aerobic bacteria. The graph shows the mean dehydrogenase activity of soil samples taken from the same depth in a soil store at different times. The bars on the graph represent two standard errors above and below the mean.



(d) (i) From what depth in the soil store would you expect these soil samples to have been taken? Use information from **Table 1** to explain your answer.

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(2)

(ii) How would you expect dehydrogenase activity to vary with depth after 6 months?

Use information from **Table 1** to explain your answer.

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(3)

(e) What do the error bars tell you about the difference between the mean dehydrogenase activity at 6 months and 3 years? Explain your answer in terms of probability and chance.

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(3)

(f) **Table 2** shows the dehydrogenase activity and the number of aerobic bacteria present in some soil samples.

Dehydrogenase activity / arbitrary units	Number of aerobic bacteria per gram of soil ($\times 10^7$)
13.1	12.0
9.2	8.7
5.5	6.5
3.0	4.6
2.2	2.7
0.4	0.6

Table 2

A sample of soil was found to have dehydrogenase activity of 8.7 arbitrary units. Explain how you would use the data in **Table 2** to predict the likely number of aerobic bacteria in 1 g of this soil sample.

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(3)

(Total 20 marks)

Q9. (a) Substances found in fallen leaves contain the elements carbon and nitrogen.
Explain how the activities of decomposers and nitrifying bacteria recycle the substances in fallen leaves for re-use by the trees.

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(b) Explain how the felling and burning of trees on a large scale could affect the concentration of carbon dioxide in the atmosphere.

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(2)

(c) Both rapidly-growing softwood trees and slow-growing hardwood trees grow in tropical rainforests. The seeds of both kinds of tree lie dormant on the floor of a mature forest and only germinate when exposed to light and warmth. However, the seedlings of many hardwood species grow more successfully beneath the protective canopy of the softwood trees.

When a small area of trees has been cut down, it can return naturally to tropical rainforest. Suggest and explain how re-establishment of the rainforest ecosystem may occur in such areas.

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(6)
(Total 15 marks)