

Ecology Questions

1. A study of plant species near a sandy shore was carried out.

The table below shows some of the data collected. Sites were sampled at a range of distances inland from a reference point on the beach

Site number	1	2	3	4	5	6
Distance from reference point / m	20	80	250	500	650	1800
Dead organic matter in soil / %	0.4	0.5	0.9	2.8	6.4	23.4
Number of plant species found	1	1	8	16	7	2

Each site represents a stage in the succession from bare sand to a climax community.

- (a) (i) Describe the changes in the percentage of dead organic matter and number of plant species as the distance from the reference point increases.

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- (ii) Suggest how changes in the percentage of dead organic matter in the soil could account for the changes in the number of plant species.

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- (b) Explain what is meant by a **climax community**.

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- (c) Another way to study plant succession is to measure changes in the percentage cover of plant species. Describe how you could measure percentage cover of a plant species in a site you have studied.

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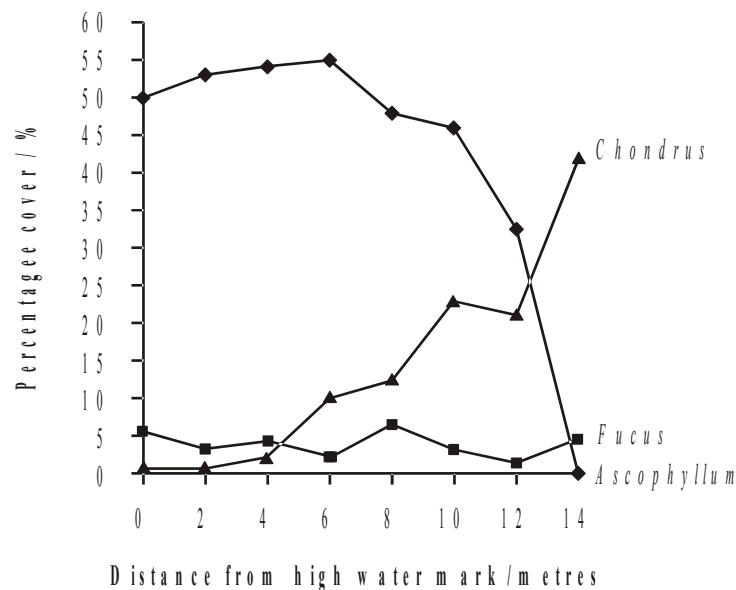
(2)

(Total 10 marks)

2. A study of the distribution and abundance of three different seaweeds was carried out in the intertidal region of a gently sloping rocky shore. The intertidal region is the area that will be covered by water as the tide comes in and uncovered by water as the tide goes out.

The abundance of each seaweed was found by estimating its percentage cover at regular intervals from the high water mark at the top of the shore to the low water mark lower down the shore.

The results of this study are shown on the graph below.



- (a) (i) Put a cross in the box next to the statement that could form part of a valid conclusion from the data shown in the graph.
- ☒ **A** – *Ascophyllum* grows only in regions that are uncovered by water for long periods of time
- ☒ **B** – *Fucus* grows better in regions that are never uncovered by water
- ☒ **C** – *Chondrus* may not be able to compete with *Ascophyllum*

(1)

- (ii) With reference to the graph discuss the validity of statements **A**, **B** and **C**.

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- (b) Suggest **two** abiotic factors, other than the length of time the seaweeds are out of water, that could affect the distribution of the seaweeds on this shore.

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- (c) Describe a technique that you have used to study the distribution of a named organism within its habitat.

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(Total 10 marks)

3. It has been estimated that only 5% of the light energy hitting the surface of a leaf reaches the chloroplasts to be used in the synthesis of organic material. The total energy used in this synthesis is known as the gross primary productivity (GPP).

- (a) Suggest **two** reasons why 95% of the light hitting the surface of a leaf is not used by the chloroplasts.

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- (b) The mean GPP for plants on Earth is $24.4 \times 10^6 \text{ J m}^{-2} \text{ year}^{-1}$.

The plants use $3.7 \times 10^6 \text{ J m}^{-2} \text{ year}^{-1}$ of this energy in metabolic processes. The energy in the remaining organic material is known as net primary productivity (NPP).

- (i) Explain what is meant by the unit $\text{J m}^{-2} \text{ year}^{-1}$.

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- (ii) Calculate the percentage of the mean GPP that remains as NPP within plants on Earth.
Show your working.

Answer%

(2)

- (iii) Place a cross **✗** in the box next to the metabolic process that best describes the process that accounts for most of the difference between GPP and NPP in plants.

☐ **A** Chemosynthesis

☐ **B** Respiration

☐ **C** Photosynthesis

☐ **D** Protein synthesis

(1)

(Total 12 marks)

4. A transect can be used to study trends in the abundance and distribution of organisms.

- (a) Describe **one** method you could use to estimate the abundance of an organism at intervals along a transect line.

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- (b) State **one** biotic factor that could be measured at each interval.

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- (c) (i) State **one** abiotic factor of soil that could determine the distribution of plants.

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(1)

- (ii) Describe how you could measure this soil factor.

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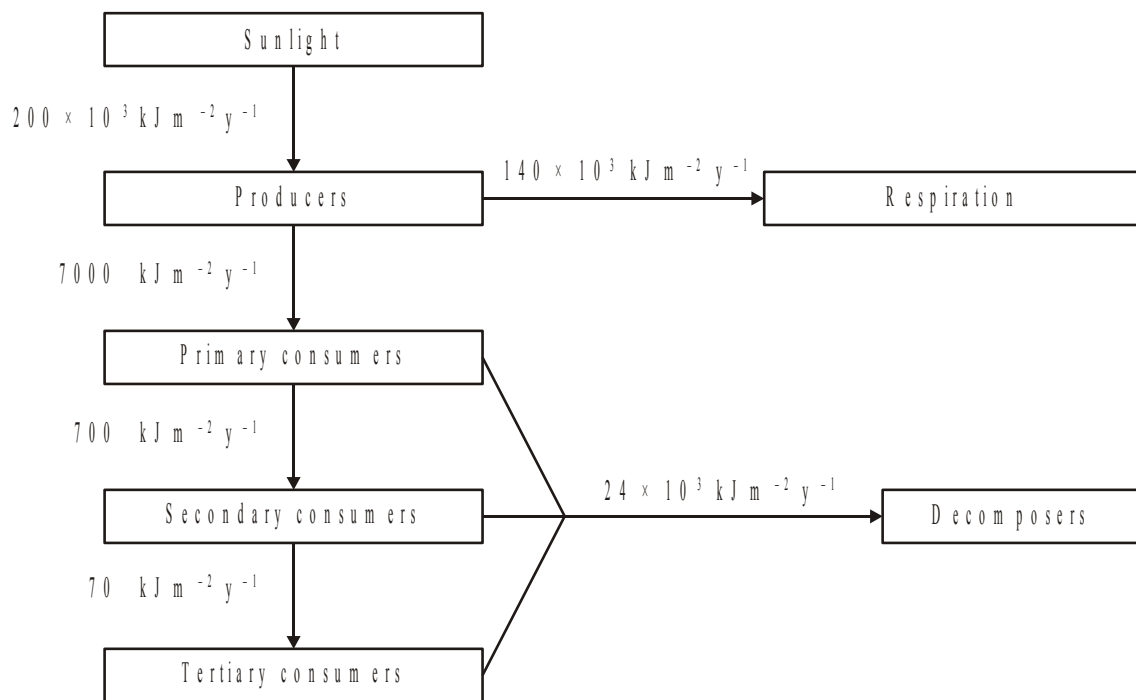
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(Total 7 marks)

5. A group of students carried out an investigation to determine the energy flow in a rainforest food chain. They collected invertebrate animals from trees, identified them and placed them in the appropriate trophic level.

For each trophic level the animals were counted, weighed and the energy content determined. Using their data and other sources of information the students produced a diagram to show the energy flow along the food chain. The diagram is shown in Figure 1.

Figure 1



Some farmers clear plots of rainforest to use for crops. The trees are felled and then burnt. This practice is called slash and burn. The soil is left covered in ash, which is rich in nutrients. However, the nutrients are soon used up by the growing crops. Within two or three years the plot is abandoned and the farmer moves on to a new plot.

The abandoned plot is colonised by tree species and eventually the land is covered by secondary rainforest. The sequence of events is shown in Figure 2. This figure also shows that the total biomass of the rainforest trees is made up of leaves, stems and branches, roots and leaf litter. These components of the biomass change as the rainforest is cleared, farmed and then abandoned.

Figure 2

	Prim ary rainforest	Farm ing	Secondary rainforest	
			10 years	25 years
	Slash and burn	Plot abandoned		
Biomass component				
Leaves	50	10	50	50
Leaf litter	400	50	200	300
Branches	50	10	50	50
Roots	200	50	50	75

The biomass components are shown in million tonnes per hectare.

- (a) Define the term **net primary production (NPP)**.

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- (b) (i) Explain why only a small percentage of the light energy falling onto a leaf is converted into chemical energy.

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- (ii) Explain why only 10% of the energy locked up in the secondary consumers is transferred to the tertiary consumers.

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- (c) The energy shown entering the decomposers in Figure 1, is much greater than that entering all of the consumers. Suggest an explanation for this difference.

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- (d) (i) Using Figure 2, compare the components of the biomass of the primary rainforest with those of the secondary rainforest after 25 years.

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- (ii) Using all of the information provided, suggest why slash and burn farming is considered to be unsustainable.

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- (e) Suggest how the biodiversity of the surrounding rainforest could be changed by the practice of slash and burn. Give reasons for your answer.

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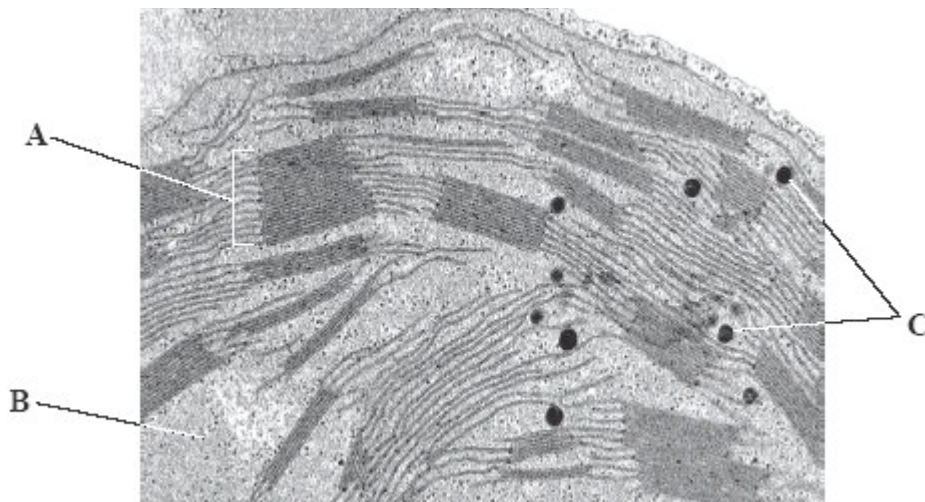
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(Total 18 marks)

7. (a) The electron microscope image below shows part of a chloroplast.



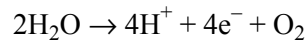
The table below gives one function of each of the three structures labelled **A**, **B** and **C** on the electron microscope image. Complete the table below by writing in the appropriate letter and the name of each structure.

Function	Label letter	Name of structure
Photophosphorylation		
Stores non-carbohydrate organic material		

Carbon fixation		
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- (b) The equation below summarises the process of photolysis of water.



- (i) Explain what happens to the electrons released by photolysis.

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- (ii) The electrons are later involved in the reduction of NADP. Explain the importance of reduced NADP in the light-independent reactions of photosynthesis.

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- (c) The rate at which plants produce carbohydrate by photosynthesis is known as gross primary productivity.

Put a cross in the box next to the equation that shows the relationship between gross primary productivity (GPP), net primary productivity (NPP) and respiration (R).

- ☒ GPP + R = NPP
- ☒ GPP + NPP = R
- ☒ GPP = NPP + R
- ☒ GPP = NPP – R

(1)

- (d) The table below shows the net primary productivity in four different ecosystems. The ecosystems in the table are listed in order of increasing distance from the equator, starting with tropical rainforest.

Ecosystem	Net primary productivity / $\text{kJ m}^{-2} \text{ year}^{-1}$
Tropical rainforest	37 800
Temperate forest	25 200
Boreal forest	14 700
Polar tundra	2 400

- (i) It is estimated that 85% of the energy available to primary consumers will not be available to secondary consumers. Calculate the energy that will be available to the secondary consumers in the **tropical rainforest**. Show your working.

Answer $\text{kJ m}^{-2} \text{ year}^{-1}$

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- (ii) Suggest **two** reasons for the differences in the net primary productivity as the distance from the equator increases.

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(Total 13 marks)

8. An investigation was carried out to find the distribution of plant species on sand dunes. A transect was used which extended inland from a beach. Quadrats were used at nine positions along the transect. The percentage cover of selected species was recorded in each quadrat as well as the number of plant species in each quadrat. A sample of soil was taken from the area within each quadrat and used to measure the mass of organic material present.



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The results are shown in the two tables below.

Quadrat number	1	2	3	4	5	6	7	8	9
Distance from top of beach / metres	0	80	170	250	500	650	980	1600	1980
Number of species found	1	1	5	11	18	7	5	2	2
Mass of organic material / grams	0.4	0.3	0.3	0.9	2.8	6.4	25.1	23.4	32.8

	Percentage cover								
Quadrat number	1	2	3	4	5	6	7	8	9
Bare sand	80	30	30	8					
Sea couch	20								
Marram grass		70	50	20	5	5			
Red Fescue			5	40	55	40			
Sea buckthorn							80		
Common heather								90	
Corsica pine									100

- (a) Explain why it is necessary to use a quadrat to estimate percentage cover.

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- (b) Explain why a transect is more appropriate than random sampling in this study.

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- (c) Use the information in both tables to compare the data collected from quadrat 1 and quadrat 5.

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- (d) Differences in the variety and number of plant species found in the different quadrats can be explained by succession. Use the information in the table to suggest how the results of the study could be explained by succession.

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(Total 12 marks)

- (c) Suggest how the data support the hypothesis that population A is the most likely to become a separate species.

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