

Foundations of Ecology

Mark Scheme



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1. Ecology is the study of how living organisms interact with each other and with their environment, helping us understand the delicate balance that sustains life on Earth.

Circle the letter of the correct answer for each.

- a) Which of the following statements best describes a '**community**' in ecological terms?

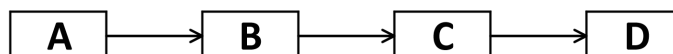
C – is the only correct answer.	1 mark
	Total: 1 mark

- b) A cactus plant has a thick, fleshy stem capable of storing large amounts of water and a widespread, shallow root system.

These features primarily help the cactus to:

B – is the only correct answer.	1 mark
	Total: 1 mark

- c) Imagine a simple diagram with four boxes, labelled A, B, C, and D, showing increasing levels of ecological organisation.



- **Box A:** Shows a single deer.
- **Box B:** Shows a group of several deer (the same species).
- **Box C:** Shows the group of deer, along with some rabbits, grasses, and trees.
- **Box D:** Shows everything in Box C, plus sunlight, soil, and a stream.

Which box in the diagram best represents an **ecosystem**?

D – is the only correct answer.	1 mark
	Total: 1 mark

(Total for Question 1 is 3 marks)

2. A group of students is studying a local woodland ecosystem.
They observe oak trees, grass, rabbits, foxes, owls, and various bacteria and fungi in the soil.

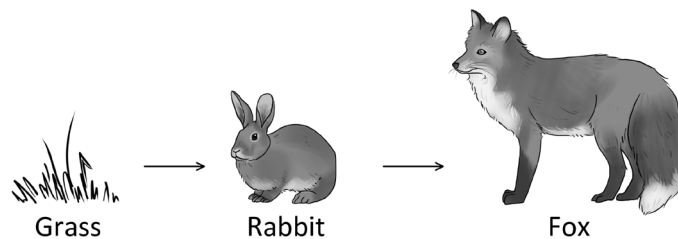
a) Define the term ecosystem.

The interaction of a community of living organisms (biotic) with the non-living (abiotic) parts of their environment.	1 mark
Must include reference to both living/biotic and non-living/abiotic components for the mark.	
	Total: 1 mark

b) From the woodland description, state one example of a population.

Any one from:	
A population of oak trees.	
A population of grass.	
A population of rabbits.	
A population of foxes.	
A population of owls.	
	Total: 1 mark

c) The students identify the following food chain in the woodland:



i. Name the producer in this food chain.

Grass.	1 mark
	Total: 1 mark

ii. What term is used to describe the rabbit in this food chain?

Primary consumer or Herbivore.	1 mark
	Total: 1 mark

iii. Explain what would likely happen to the fox population if a disease significantly reduced the rabbit population.

An explanation to include any two of the following:	
The fox population would decrease/decline.	1 mark
(Because) there is less food available for the foxes.	1 mark
Leading to) starvation / increased competition (for other food sources).	1 mark
	Total: 2 marks

- d) Other than the organisms mentioned, list two abiotic factors that could affect the growth of the oak trees in the woodland.

Any two from:	
• Light (intensity). • Temperature. • Water / moisture / rainfall. • Soil pH. • oil mineral content / nutrients. • Wind (intensity / direction). • Carbon dioxide (concentration)/Oxygen (concentration).	
	Total: 2 marks

- e) Explain how one of the abiotic factors you listed in (d) could affect the growth of the oak trees.

An explanation linking one chosen factor from (d) to the growth of the oak trees.	
For light: (Less light) would reduce the rate of photosynthesis. (Therefore) less glucose/food would be produced for growth/respiration.	1 mark 1 mark
For less Water: (Lack of water) would reduce the rate of photosynthesis. (Because) water is a reactant for photosynthesis / lack of water causes wilting/reduces turgor pressure.	1 mark 1 mark
For Soil minerals: (Lack of minerals e.g. nitrates) means the plant cannot make proteins/amino acids. Proteins are needed for growth.	1 mark 1 mark
	Total: 2 marks

- f) Bacteria and fungi in the soil are decomposers.
Describe the role of decomposers in an ecosystem.

Any two from:	
They break down dead organic matter / dead organisms / waste products (e.g. faeces/urine). (By) releasing / secreting enzymes. This releases / recycles mineral ions / nutrients. (Which are then) returned to the soil for plants/producers to absorb/use.	
	Total: 2 marks

(Total for Question 2 is 12 marks)

3. A large area of woodland is cleared to build a new housing estate.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Simple statements are made about the effects of deforestation on at least one of the areas mentioned. The links to the roles of trees are limited or absent. The answer may be disjointed and lack a clear structure.
Level 2	3 - 4	An explanation is provided that links the effects of deforestation to at least two of the areas mentioned. There are clear attempts to link the effects to the roles of trees, but the explanation may lack some detail or coherence. The answer has some logical structure.
Level 3	5 - 6	A detailed and coherent explanation is provided that links the effects of deforestation to all three areas mentioned (animal populations, atmospheric gases, and soil). The roles of trees in the ecosystem are clearly explained and used to justify the predicted effects. The answer is well-organised and uses appropriate scientific terminology.

Indicative content:	
Effects on animal populations: - Trees provide habitat/shelter for many animal species (e.g., birds, insects, squirrels). - Deforestation destroys these habitats, leading to a decrease in animal populations. - Animals may be forced to migrate, increasing competition in other areas. - Trees are producers, providing a food source for herbivores. - Loss of trees removes food sources, causing animals to starve and populations to decline. - Overall, this leads to a reduction in biodiversity. Effects on the balance of atmospheric gases: - Trees carry out photosynthesis, removing carbon dioxide from the atmosphere. - Deforestation means less carbon dioxide is taken in. - Trees release oxygen during photosynthesis. - Deforestation means less oxygen is released. - Trees store carbon in their biomass. - If the cleared trees are burned (combustion), this stored carbon is released as carbon dioxide. - This increases the concentration of carbon dioxide in the atmosphere, contributing to the greenhouse effect / global warming. Effects on the local soil: - Tree roots help to bind the soil together, preventing soil erosion. - The tree canopy intercepts heavy rainfall, reducing its impact on the ground. - Without trees, soil is more easily washed or blown away (erosion). - Dead leaves from trees fall and decompose, returning nutrients/minerals to the soil. - Deforestation stops this nutrient cycling, leading to less fertile soil. - Leaching of minerals from the soil may increase. To achieve full marks, students must provide a coherent answer that addresses all three topics, linking them to the roles of trees. For example, a student might explain that because the role of trees is to provide a habitat, deforestation leads to a reduction in animal populations.	
	Total: 6 marks

(Total for Question 3 is 6 marks)

4. The image below shows a cactus plant, which is commonly found in hot, dry desert environments.



- a) Describe **two** structural adaptations of a cactus plant that help it to reduce water loss.
For each adaptation, explain how it helps to reduce water loss.

Any two of the following pairs:	
Adaptation 1: Leaves are reduced to spines/needles. Explanation: This reduces the surface area (for transpiration).	
Adaptation 2: Has a thick, waxy cuticle. Explanation: This provides a waterproof layer / reduces water loss by evaporation from the stem surface.	
Adaptation 3: Fewer stomata / stomata are in pits/grooves (sunken). Explanation: Fewer stomata reduce the number of pores for water to escape / Sunken stomata trap moist air, reducing the water potential gradient.	
Adaptation 4: Low surface area to volume ratio / rounded or fleshy stem. Explanation: Minimises the surface for water loss relative to the volume for water storage.	
	Total: 4 marks

- b) Cacti have very shallow, widespread root systems or very deep taproots.
Explain how one of these root system types is an adaptation for survival in a desert environment.

An explanation to include one of the following:	1 mark
For shallow, widespread roots: They cover a large surface area. To absorb water quickly after rainfall (before it evaporates).	1 mark 1 mark
For very deep taproots: They reach deep into the ground. To access underground water sources / the water table.	1 mark 1 mark
	Total: 2 marks

- c) Some species of cactus open their stomata only at night to take in carbon dioxide for photosynthesis, which then occurs during the day. Suggest how this behaviour is an adaptation to its desert environment.

It is cooler at night. (Therefore) less water is lost through the stomata (by evaporation/transpiration).	1 mark
	Total: 1 mark

(Total for Question 4 is 7 marks)

5. The diagram below shows **two** species of bird, Bird A and Bird B, that live in the same woodland and feed on insects found on oak trees.



- a) Define the term 'community'.

(All) the populations of different species living in a habitat.	1 mark
Marking note: an answer that must include the idea of different species/populations.	
	Total: 1 mark

- b) State the resource that Bird A and Bird B are most likely competing for.

Food / Insects.	1 mark
	Total: 1 mark

- c) Scientists observed that Bird A tends to feed on insects found on the thicker branches and trunk of the oak trees, while Bird B mainly feeds on insects found on the thinner, outer twigs and leaves.

Explain how this difference in feeding behaviour benefits both bird species.

An explanation to include any two from:	
(There is) less / reduced competition (between the two species).	1 mark
For food / insects.	1 mark
(Therefore) both species are more likely to get enough food to survive and reproduce.	1 mark
They occupy different niches.	1 mark
	Total: 2 marks

- d) A disease suddenly kills a large number of the oak trees in the woodland.

Suggest how this decrease in oak trees might affect the population size of Bird A. Explain your answer.

Suggestion: The population of Bird A would decrease.	1 mark
Explanation: any one from:	
- Fewer oak trees means there is less habitat/food for the insects, so the insect population decreases. (Therefore) there is less food available for Bird A. - There is less space / fewer nesting sites for Bird A. - Increased competition for remaining food/habitat.	1 mark
	Total: 2 marks

(Total for Question 5 is 6 marks)

6. A biologist is studying a freshwater pond ecosystem.

a) Define the term 'population' using an example from the pond ecosystem.

A population is all the organisms of a single species living in a habitat, e.g., all the stickleback fish in the pond.	1 mark
	Total: 1 mark

b) All the different populations living together in the pond form a 'community'.

Name **one** other organism that would be part of this pond community, but is not explicitly listed in the description above.

Any one from: • Algae. • Bacteria. • Fungi. • Frogs / Tadpoles. • Newts. • Other named pond plant/insect/animal.	
	Total: 1 mark

c) From the information given about the pond:

i. List **two biotic (living) factors** that could directly affect the population size of the stickleback fish.

Any two from: • (Number of) predators / herons. • Availability of food / (number of) pond snails / dragonfly larvae. • Disease / pathogens. • Competition (with other fish/species).	
	Total: 2 marks

ii. List **two abiotic (non-living) factors** that could affect the growth of the pondweed.

Any two from: • Light intensity. • Water temperature. • Oxygen concentration. • Carbon dioxide (concentration). • pH (of water). • Mineral / ion / nutrient content (of water).	
	Total: 2 marks

d) Explain how a significant decrease in the population of pond snails could affect the population of dragonfly larvae in the pond. Assume dragonfly larvae feed on pond snails.

The population of dragonfly larvae would decrease.	1 mark
(Because) there would be less food available for them / increased competition for food.	1 mark
	Total: 2 marks

e) Pondweed is a producer.

Explain **one** reason why producers like pondweed are essential for the survival of animals, such as the stickleback fish, in the pond ecosystem.

Any one of the following reasons with a linked explanation:	
Reason 1: Food source. Pondweed is a source of food / at the start of the food chain. Explanation: It provides energy / biomass for other organisms in the pond.	
Reason 2: Oxygen production. Pondweed releases oxygen (through photosynthesis). Explanation: Animals like fish need this oxygen for respiration.	
Reason 3: Habitat. Pondweed provides a habitat / shelter. Explanation: This protects animals from predators / provides a place to lay eggs.	
	Total: 2 marks

(Total for Question 6 is 10 marks)