

# GCSE / IGCSE Biology – Ecology

GCSE/IGCSE (Edexcel/AQA/Cambridge) · Total marks: 36 · Answers on the last page

Practice questions covering ecosystems and feeding relationships, sampling techniques, and nutrient cycles and biodiversity, matching the GCSE/IGCSE Biology specification. A calculator is required for the numerical questions.

## Section A – Ecosystems and Feeding Relationships

1. Define the following terms:  
(a) ecosystem  
(b) population  
(c) community. [3]
2. In the food chain grass → rabbit → fox:  
(a) Identify the producer, the primary consumer, and the secondary consumer.  
(b) State the ultimate source of energy that enters this food chain. [3]
3. In a food chain, 12000 kJ of energy is available at the producer trophic level, and 1320 kJ is transferred to (available at) the primary consumer level.  
(a) Calculate the percentage efficiency of energy transfer between these two trophic levels.  
(b) State two reasons why not all of the energy available at one trophic level is transferred to the next. [4]
4. Explain why a pyramid of biomass for a food chain is usually a regular, upright pyramid shape, whereas a pyramid of numbers for the same food chain can sometimes be an unusual shape (for example, inverted). [3]

## Section B – Sampling Techniques (Calculator required)

5. A student estimates the population of daisies in a field of area 800 m<sup>2</sup> using six randomly placed quadrats, each of area 0.25 m<sup>2</sup>. The numbers of daisies counted in each quadrat are: 6, 8, 5, 7, 9, 6.  
(a) Calculate the mean number of daisies per quadrat.  
(b) Estimate the total number of daisies in the whole field. [5]
6. Explain why quadrats used to sample a population should be placed randomly (for example, using random number coordinates on a grid), rather than the student choosing where to place them. [2]
7. To estimate the population of snails in a garden, 50 snails are caught, marked in a harmless way, and released. Some time later, 60 snails are caught, of which 12 are found to be marked. Use the Lincoln index (mark-release-recapture method) to estimate the total population of snails in the garden. [3]
8. State two assumptions that must be true for the mark-release-recapture method to give an accurate estimate of population size. [2]

## Section C – Nutrient Cycles and Biodiversity

9. Describe, using the terms decomposition and combustion, how carbon dioxide is returned to the atmosphere as part of the carbon cycle. [3]

10. Describe the role of (a) nitrogen-fixing bacteria and (b) decomposers in the nitrogen cycle. [3]
11. Give two reasons why it is important to maintain biodiversity. [2]
12. Explain, using deforestation as an example, how a human activity can reduce biodiversity, and describe one method used to help maintain biodiversity. [3]

## Answers

*Check your working against these. If an answer does not match, try the question again before looking for the method.*

- Ecosystem: the interaction of a community of living organisms with the non-living (abiotic) parts of their environment.
  - Population: all the organisms of one species living in a particular area at a particular time.
  - Community: all the populations of different species living and interacting together in a particular area.
- Producer: grass. Primary consumer: rabbit. Secondary consumer: fox.
  - The Sun (light energy).
- Efficiency =  $\frac{1320}{12000} \times 100 = 11.0\%$ .
  - Energy is lost as heat to the surroundings through respiration; energy is used for movement and other life processes; some parts of the organism (e.g. bones, roots) are not eaten by the next consumer; some material eaten is not digested and is lost in faeces (any two).
- A pyramid of biomass measures the total mass of living material at each trophic level, and since energy (and therefore biomass) decreases at each successive trophic level, biomass pyramids are almost always a regular upright shape. A pyramid of numbers simply counts individual organisms, so it can become an unusual shape (e.g. inverted) when the producer is very large compared with the consumers, such as one large tree supporting a huge number of small insects, even though the tree's biomass is far greater than that of the insects.
- Mean =  $\frac{6 + 8 + 5 + 7 + 9 + 6}{6} = 6.83$  daisies per quadrat.
  - Density =  $\frac{6.83}{0.25} = 27.3$  daisies per m<sup>2</sup>. Estimated total =  $27.3 \times 800 \approx 21900$  daisies.
- Placing quadrats randomly avoids bias, since a student might unconsciously choose areas that look like they have more (or fewer) organisms, which would not give a representative sample of the whole area and would make the population estimate unreliable.
- Population estimate =  $\frac{\text{number marked first catch} \times \text{total in second catch}}{\text{number marked in second catch}} = \frac{50 \times 60}{12} = 250$  snails.
- The marked individuals must have enough time to mix fully back into the population before the second sample is taken; the population must not change significantly between the two samples (negligible births, deaths, immigration or emigration); the marking must not affect the survival or behaviour of the marked individuals, and marked and unmarked individuals must have an equal chance of being caught (any two).
- Decomposers (bacteria and fungi) break down (decompose) the carbon compounds in dead organisms and waste material through respiration, releasing carbon dioxide back into the atmosphere. Combustion of fossil fuels (formed from the remains of dead organisms over millions of years) and of wood also releases carbon, stored in these materials, back into the atmosphere as carbon dioxide.
- Nitrogen-fixing bacteria (found in root nodules of leguminous plants or free-living in soil) convert nitrogen gas from the air into nitrogen-containing compounds (such as ammonium or nitrate ions) that plants can absorb and use to make proteins.
  - Decomposers break down proteins and urea in dead organisms and waste products into ammonia/ammonium ions, which can then be converted into nitrates by nitrifying bacteria and taken up again by plants.

11. Biodiversity ensures ecosystems remain stable and resilient to change (e.g. disease, climate change), since a wide variety of interdependent species provides more food sources and habitats; it also provides genetic resources for medicines, food crops and other products, and maintains the aesthetic, cultural and recreational value of natural environments (any two reasons).
12. Deforestation destroys the habitats of the many species living in a forest, reducing the food and shelter available to them; this can lead to a fall in population sizes or local extinction of species that depend on the forest, reducing the overall biodiversity of the area. Method to help maintain biodiversity: setting up protected areas/nature reserves where habitats cannot be destroyed; breeding programmes in zoos/captivity for endangered species; or seed banks to preserve plant genetic diversity (any one).

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