Ecology

Model answers and marking points

GCSE science 6-mark questions

This topic online

1 In a woodland in Kent, carbon atoms are constantly recycled between the air, living things and dead material.

Describe how carbon is cycled in the woodland. (6 marks)

Model answer

Carbon is found in the air as carbon dioxide. The trees and other plants in the woodland take in carbon dioxide for photosynthesis. They use it to make glucose, which is then used to make other carbon compounds such as starch, cellulose and proteins. So the carbon becomes part of the plants' biomass.

When animals such as rabbits and caterpillars eat the plants, the carbon compounds pass into their bodies. The carbon then moves along the food chain when they are eaten by predators, such as foxes or birds.

All of these living things respire. Respiration releases carbon dioxide back into the air.

When plants and animals die, or when animals produce waste such as droppings, the carbon is in dead material. Decomposers, such as bacteria and fungi, feed on this material and break it down. The decomposers also respire, so they release the carbon back into the air as carbon dioxide. Decay also returns mineral ions to the soil for plants to take up.

If wood is burned, for example in a wildfire, combustion also releases carbon dioxide into the air.

Marking points (credit any 6 relevant points, linked in a sensible order)

- carbon is in the air as carbon dioxide
- plants take in carbon dioxide for photosynthesis and use it to make glucose and other carbon compounds
- carbon passes to animals when they eat plants, and along food chains
- plants, animals and microorganisms release carbon dioxide into the air by respiration
- when plants and animals die, or produce waste, the carbon is in dead material
- decomposers such as bacteria and fungi break down the dead material
- decomposers release carbon dioxide into the air by respiration
- decay also returns mineral ions to the soil
- burning wood or fossil fuels (combustion) also releases carbon dioxide

How it is marked

- 5-6 marks: describes how carbon is taken in by photosynthesis, passed along food chains and returned by respiration and decomposition, in a clear cycle.
- 3-4 marks: describes photosynthesis and respiration with some mention of feeding or decay, but the cycle is incomplete.
- 1-2 marks: names one or two processes with no clear link between them.

What loses marks

- saying plants do not respire
- saying decomposers release carbon by photosynthesis or straight into the soil as carbon dioxide
- describing processes with no idea of a cycle

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2 On a Scottish estate, wildlife officers counted mountain hares (prey) and golden eagles (predators) over eight years.

Year	Number of hares	Number of eagles
1	400	6
2	650	7
3	800	10
4	550	14
5	300	12
6	250	8
7	450	6
8	700	7

Use the data to describe and explain the changes in the two populations. (6 marks)

Model answer

The number of hares rose from 400 in year 1 to a peak of 800 in year 3. With few eagles and plenty of food, more hares survived and bred.

The eagles peaked a year later, at 14 in year 4. With more hares to eat, more eagles survived and could raise more young, so their population increased.

From year 3 to year 6 the hares fell from 800 to 250. This is because the larger number of eagles ate more of them.

Once the hares had fallen, the eagles had less food. Fewer survived or bred, so the eagle population fell from 14 to 6 by year 7.

With fewer eagles, fewer hares were eaten, so the hare population rose again to 700 by year 8, starting the cycle again.

The peak in eagle numbers comes a year after the peak in hare numbers, because it takes time for the predators to respond to changes in their food supply. There are many fewer eagles than hares because energy is lost at each stage of a food chain. Other factors, such as the amount of plant food for the hares or disease, could also affect the numbers.

Marking points (credit any 6 relevant points, linked in a sensible order)

- hares rise from 400 in year 1 to a peak of 800 in year 3
- with plenty of food the hares survive and breed, so their numbers rise
- eagles rise to a peak of 14 in year 4, one year after the hares peak
- more hares means more food for eagles, so more eagles survive and raise young
- hares fall to 250 by year 6 because more are eaten by the larger number of eagles
- eagle numbers fall after year 4 because there are fewer hares to eat
- with fewer eagles, the hares increase again from year 7
- the predator peak lags behind the prey peak; the populations cycle
- there are far fewer eagles than hares because energy is lost at each trophic level
- other factors such as food plants, disease or weather could also affect numbers

How it is marked

- 5-6 marks: describes both patterns with figures, explains the cause of each rise and fall in terms of the other population, and notes the time lag.
- 3-4 marks: describes the patterns with some data and gives a partial explanation.
- 1-2 marks: describes one trend, such as hares go up and down.

What loses marks

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- describing the patterns with no numbers
- explaining the eagle changes without linking them to the hares
- missing the time lag between the peaks

3 Large areas of tropical rainforest are being cleared to grow crops for biofuels and to graze cattle.

Explain how this deforestation affects biodiversity and the composition of the atmosphere. (6 marks)

Model answer

Biodiversity is the variety of all the different species of organisms in an area. Rainforests have a very high biodiversity.

When the forest is cleared, the habitats of many animals and plants are destroyed, so they lose their food and shelter. Some species, especially those found only in that area, may become extinct. The land is then used to grow a single crop or as grassland for cattle, which supports far fewer species than the forest did. Organisms in an ecosystem depend on each other, so losing one species can cause others in the food web to decline too. All of this reduces biodiversity.

Deforestation also changes the atmosphere. Trees take in carbon dioxide for photosynthesis and store the carbon in their wood, so with fewer trees less carbon dioxide is removed from the air. The trees are often burned to clear the land, which releases carbon dioxide by combustion. Microorganisms that decay the leftover wood also release carbon dioxide when they respire. Cattle also produce methane.

Carbon dioxide and methane are greenhouse gases, so increasing them in the atmosphere contributes to global warming.

Marking points (credit any 6 relevant points, linked in a sensible order)

- biodiversity is the variety of all the different species in an ecosystem
- clearing the forest destroys habitats, so many species lose food and shelter
- species may become extinct, reducing biodiversity
- replacing forest with one crop (monoculture) supports far fewer species
- because organisms are interdependent, losing one species affects others in food webs
- trees take in carbon dioxide for photosynthesis, so fewer trees means less carbon dioxide removed from the air
- trees are often burned, releasing carbon dioxide by combustion
- decay of left-over wood by microorganisms releases carbon dioxide by respiration
- cattle release methane
- more carbon dioxide and methane in the atmosphere contribute to global warming

How it is marked

- 5-6 marks: explains how loss of habitat and monoculture reduce biodiversity and explains at least two ways the atmosphere changes, linked to global warming.
- 3-4 marks: explains either the biodiversity effects or the atmosphere effects well, with a brief mention of the other.
- 1-2 marks: states that animals lose their homes or that carbon dioxide increases.

What loses marks

- saying deforestation reduces oxygen so people cannot breathe
- saying the hole in the ozone layer causes global warming
- not defining or using the idea of biodiversity

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4 A supermarket is deciding whether to sell more farmed salmon or more wild-caught salmon. It is given this information.

Farmed salmon	Wild salmon
Kept in large cages in Scottish sea lochs	Caught at sea
Movement limited; fed high-protein food	Fish move freely and find their own food
Disease and parasites spread easily; treated with chemicals	Some stocks are falling due to overfishing
Lower price for shoppers	Higher price; supply varies

Evaluate selling farmed salmon compared with wild salmon. Give a justified conclusion.

Separate science only

(6 marks)

Model answer

In farmed salmon, the cages limit how much the fish move. This means less energy is transferred by respiration for movement, so more of the energy from their food goes into growth. This makes food production more efficient, giving more fish at a lower price for shoppers and helping food security.

However, the fish are kept close together, so disease and parasites spread easily, and these can also spread to wild fish nearby. The chemicals used to treat them, as well as waste from the cages, can pollute the lochs. Some people also object to keeping fish in crowded cages for welfare reasons. Farmed salmon are also fed high-protein food, which may be made from other wild-caught fish.

Wild salmon are free to move and find their own food, so there are no welfare concerns about cages and no chemicals are added. But some fish stocks are falling because of overfishing, and if too many are caught, breeding populations may not recover. Fishing quotas and controls on net size can help keep stocks sustainable. Wild salmon is also more expensive and the supply varies.

I think the supermarket should sell mostly farmed salmon from well-managed farms, because it is cheaper and reduces pressure on falling wild stocks, while only selling wild salmon from sustainable fisheries.

Marking points (credit any 6 relevant points, linked in a sensible order)

- farming limits the movement of the fish, so less energy is transferred by respiration
- more energy goes into growth, so the efficiency of food production is higher
- this gives more fish at a lower price, which helps food security
- farmed fish are fed high-protein food, which may itself come from wild-caught fish
- fish kept close together spread disease and parasites easily, which can spread to wild fish
- chemicals and waste from cages can pollute the lochs
- some people have welfare concerns about fish kept in crowded cages
- wild fishing does not need feeding or chemicals, but overfishing is reducing stocks
- fish stocks can be protected with net size controls and fishing quotas
- a justified conclusion

How it is marked

- 5-6 marks: explains why farming is more efficient in terms of energy transfer, weighs this against disease, pollution, welfare and the impact of overfishing, and reaches a reasoned conclusion.
- 3-4 marks: gives advantages and disadvantages of both with some explanation, conclusion weak.
- 1-2 marks: lists one or two points from the table with no evaluation.

What loses marks

- saying farmed fish need less food without linking to energy transfer
- ignoring the effect of overfishing on wild stocks
- giving a conclusion that does not follow from the points

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5 Zainab has a compost bin in her garden in Birmingham. In winter, her grass cuttings and vegetable peelings take months to rot. In summer they rot in a few weeks.

Suggest why the waste rots faster in summer, and suggest how Zainab could make her compost form more quickly all year round.

Separate science only

(6 marks)

Model answer

The waste is broken down by decomposers, such as bacteria and fungi. They release enzymes that digest the waste, and they respire using the products.

In summer the temperature is higher. The decomposers' enzymes work faster when warm, and the decomposers grow and reproduce faster, so there are more of them breaking the waste down. In winter it is cold, so their enzymes work slowly and decay takes months.

To make compost form faster all year round, Zainab could put the bin in a sunny, sheltered place or insulate it, to keep the temperature higher.

She should keep the compost moist, because decomposers need water to survive and for their enzymes to work, but not so wet that it becomes waterlogged.

She should turn the compost regularly or use a bin with air holes, so oxygen can reach the decomposers. They need oxygen for aerobic respiration, which releases more energy and lets them work faster.

She could also chop the waste into small pieces, giving a larger surface area for the decomposers to act on.

The finished compost can then be used as a natural fertiliser, returning mineral ions to her soil.

Marking points (credit any 6 relevant points, linked in a sensible order)

- decay is carried out by decomposers such as bacteria and fungi
- decomposers use enzymes to break down the waste and respire
- in summer the temperature is higher, so enzymes in decomposers work faster
- decomposers grow and reproduce faster when warm
- in winter it is colder, so enzyme activity and decay are slow
- insulating the bin or putting it in a sunny place keeps it warmer
- decomposers need water: keep the compost moist but not waterlogged
- decomposers need oxygen for aerobic respiration: turn the compost or use a bin with air holes
- chopping waste into small pieces gives a larger surface area for decomposers
- compost returns mineral ions to the soil as a natural fertiliser

How it is marked

- 5-6 marks: explains the effect of temperature on decomposers and their enzymes, and suggests at least two other ways to speed up decay, each with a reason.
- 3-4 marks: explains the temperature effect simply and gives one or two suggestions with limited reasons.
- 1-2 marks: states that it is warmer in summer, or gives a suggestion with no reason.

What loses marks

- saying decomposers die in the cold rather than slow down
- saying higher temperature always helps, ignoring that too hot denatures enzymes
- giving suggestions without saying why they work

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