This is the **Higher Combined Science** version. Higher Tier questions (★) are included. Some Separate-only content has been omitted.

Ecosystems and Adaptations (4.7.1)

Specification reference: 4.7.1

Q1. Explain the difference between abiotic and biotic factors. Give ONE example of each.

[3 marks]

Q2. Describe how a predator-prey relationship leads to cyclical changes in population size over time.

[3 marks]

Q3. Explain what is meant by an adaptation. Describe ONE structural, ONE behavioural and ONE physiological adaptation of an organism to its environment.

[3 marks]

Food Chains and Energy Transfer (4.7.2 and 4.7.4)

Specification reference: 4.7.2

Q4. Explain why food chains rarely have more than five trophic levels.

[3 marks]

Q5. A student claims that eating a plant-based diet is better for the environment than a meat-based diet. Evaluate this claim using your knowledge of energy transfer in food chains.

[4 marks]

★ HIGHER TIER

Q6. ★ A grassland ecosystem has: grass (10,000 kg), rabbits (1,000 kg), foxes (100 kg). Calculate the efficiency of energy transfer from rabbits to foxes, and suggest why this value is so low.

[3 marks]

The Carbon Cycle (4.7.2.2)

Specification reference: 4.7.2.2

Q7. Describe how carbon is cycled between the atmosphere and living organisms.

[4 marks]

Q8. Explain why burning fossil fuels is considered more damaging to the carbon cycle than burning wood from sustainably managed forests.

[3 marks]

★ HIGHER TIER

Q9. ★ Explain what is meant by a carbon sink and give TWO examples.

[3 marks]

Biodiversity and Human Impact (4.7.3)

Specification reference: 4.7.3

Q10. Describe THREE consequences of deforestation.

[3 marks]

Q11. Evaluate TWO different methods of conserving biodiversity.

[4 marks]

★ HIGHER TIER

Q12. ★ Describe the nitrogen cycle, naming FOUR types of bacteria involved and their roles.

[4 marks]

Total: 40 marks

Ecosystems and Adaptations (4.7.1)

Q1 (3 marks)

Explain the difference between abiotic and biotic factors. Give ONE example of e…

• Abiotic: non-living physical/chemical factor affecting organisms [1]; example: temperature, light, pH, water, wind [1]

• Biotic: living factor affecting organisms [1]; example: food availability, predators, disease, competition [1] — 3 marks: definition of both + example of either

Q2 (3 marks)

Describe how a predator-prey relationship leads to cyclical changes in populatio…

• Prey population increases → more food for predators → predator population increases [1]

• More predators → more predation → prey population falls [1]

• Less prey → predators struggle for food → predator numbers fall → prey recovers → cycle repeats [1]

Q3 (3 marks)

Explain what is meant by an adaptation. Describe ONE structural, ONE behavioural…

• Adaptation: an inherited characteristic that increases an organism's chance of surviving and reproducing in its environment [1]

• Structural example: polar bear has thick fur to provide insulation in cold Arctic [1]

• Behavioural example: migration to warmer regions in winter to find food [1] — physiological: camel stores fat in hump for energy, not water

Food Chains and Energy Transfer (4.7.2 and 4.7.4)

Q4 (3 marks)

Explain why food chains rarely have more than five trophic levels.

• Energy is lost at each trophic level through respiration (as heat), movement and waste [1]

• Only approximately 10% of energy transfers to the next trophic level [1]

• After 5 levels so little energy remains that another level cannot be supported [1]

Q5 (4 marks)

A student claims that eating a plant-based diet is better for the environment th…

• Claim is largely correct [1]

• Plants are producers — eating plants is eating at the first trophic level [1]

• Only ~10% of plant biomass transfers to the animal — so much more plant material is needed to produce the same mass of meat [1]

• Less land/energy needed to grow plant food directly than to raise livestock → smaller environmental footprint [1]

Q6 (3 marks) [★ HT]

★ A grassland ecosystem has: grass (10,000 kg), rabbits (1,000 kg), foxes (100 k…

• Efficiency = (100 ÷ 1000) × 100 = 10% [1]

• Energy is lost through: respiration (generating heat), movement, undigested material in faeces [1]

• Only energy stored in new body tissue (growth) is available to the next trophic level [1]

The Carbon Cycle (4.7.2.2)

Q7 (4 marks)

Describe how carbon is cycled between the atmosphere and living organisms.

• CO■ is removed from the atmosphere by photosynthesis — fixed into organic molecules in plants [1]

• Carbon passes along food chain as organisms eat each other [1]

• Returned to atmosphere by respiration in all organisms [1]

• Returned by decomposition of dead organisms (decomposers respire releasing CO■) and combustion [1]

Q8 (3 marks)

Explain why burning fossil fuels is considered more damaging to the carbon cycle…

• Fossil fuels contain carbon fixed millions of years ago — a net addition of carbon to the atmosphere [1]

• Burning fossil fuels releases this ancient carbon much faster than natural cycles can reabsorb it [1]

• Sustainably managed forests: new trees planted absorb CO■ as they grow — approximately carbon neutral over time [1]

Q9 (3 marks) [★ HT]

★ Explain what is meant by a carbon sink and give TWO examples.

• A carbon sink is a reservoir that absorbs and stores more carbon than it releases [1]

• Example 1: oceans — CO■ dissolves in seawater; absorbed by phytoplankton and marine organisms [1]

• Example 2: forests — trees absorb CO■ through photosynthesis storing carbon in wood and leaves [1]

Biodiversity and Human Impact (4.7.3)

Q10 (3 marks)

Describe THREE consequences of deforestation.

• Habitat destruction → loss of biodiversity and species extinction [1]

• Release of stored carbon as CO■ (through burning or decomposition) → contributes to global warming [1]

• Loss of tree roots → soil erosion and disruption of water cycle [1]

Q11 (4 marks)

Evaluate TWO different methods of conserving biodiversity.

• Nature reserves: protect habitats from development [1]; may be too small for viable populations / cannot prevent climate change [1]

• Captive breeding programmes: maintain populations of endangered species [1]; can reintroduce to wild but animals may lose natural behaviours / expensive [1] — accept any two methods evaluated with benefit + limitation

Q12 (4 marks) [★ HT]

★ Describe the nitrogen cycle, naming FOUR types of bacteria involved and their …

• Nitrogen-fixing bacteria: convert atmospheric N■ into ammonia/nitrates in soil or root nodules [1]

• Nitrifying bacteria: convert ammonia into nitrites then nitrates in soil — available for plants [1]

• Decomposers: break down dead organic matter releasing ammonia [1]

• Denitrifying bacteria: convert nitrates back into N■ gas — return nitrogen to atmosphere [1]