MARK SCHEME

OCR Gateway GCSE Biology A · Paper 2: Community-Level Systems, Similarities and Differences, Life on Earth (B4–B6)

Higher Tier — Combined Science · Total: 70 marks

This mark scheme is designed for use by examiners. Alternative correct answers should be accepted. Marks in brackets [1] indicate one mark. Points separated by / indicate alternatives. Underlined words are essential. ★ indicates Higher Tier only marks.

Question 1 [4 marks]

(a) [1 mark]

What is the role of nitrogen-fixing bacteria in the nitrogen cycle?

• B. Convert atmospheric nitrogen into ammonia or nitrates [1]

(b) [1 mark]

Two heterozygous tall pea plants (Tt × Tt) are crossed. What is the expected ratio of tall to short …

• C. 3:1 [1]

(c) [1 mark]

Which of the following correctly describes a food chain?

• B. An arrow showing the direction of energy transfer from prey to predator [1]

(d) [1 mark]

Which process removes CO■ from the atmosphere?

• D. Photosynthesis [1]

Total for question 1: 4

Question 2 [7 marks]

Scientists are investigating a woodland ecosystem. They have collected data on the biomass of organisms at different tro…

(a) [2 marks]

Explain why a pyramid of biomass is always widest at the base.

• Producers (base) have the greatest total biomass [1]

• Only ~10% of biomass/energy transfers to the next trophic level — most is lost through respiration, movement and waste [1]

(b) [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 excretion/faeces [1]

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

• After 5 levels, so little energy remains that there would not be enough to sustain another population [1]

(c) ★ [2 marks]

★ The biomass of primary producers in the woodland is 50,000 kg. Assuming 10% efficiency of energy …

• Primary consumers: 50,000 × 0.1 = 5,000 kg [1]

• Secondary consumers: 5,000 × 0.1 = 500 kg [1]

Total for question 2: 7

Question 3 [8 marks]

This question is about the carbon and nitrogen cycles.

(a) [4 marks]

Describe the carbon cycle. In your answer, state which process removes CO■ from the atmosphere, and …

- Only photosynthesis removes CO■ from the atmosphere [1]
- Respiration (in all organisms) returns CO■ to atmosphere [1]
- Decomposition: bacteria and fungi respire as they break down dead matter → CO■ released [1]
- Combustion (burning fossil fuels or wood) releases stored carbon as CO■ [1]

(b) ★ [4 marks]

★ Describe the nitrogen cycle. Your answer should include the names and roles of four types of bact…

- Nitrogen-fixing bacteria: convert atmospheric N■ → ammonia/nitrates in soil or legume root nodules [1]
- Nitrifying bacteria: convert ammonia → nitrites → nitrates (available for plant uptake) [1]
- Decomposers: break down dead organic matter → release ammonia (ammonification) [1]
- Denitrifying bacteria: convert nitrates → N■ gas → return nitrogen to atmosphere [1]

Total for question 3: 8

Question 4 [10 marks]

Scientists are studying the effects of human activity on biodiversity.

(a) [4 marks]

Explain how eutrophication can lead to the death of aquatic organisms. Start with the application of…

- Fertilisers (nitrates/phosphates) wash off agricultural land into rivers/lakes [1]
- Algae grow rapidly (algal bloom) on water surface, blocking sunlight [1]
- Aquatic plants below die → bacteria decompose dead matter, consuming dissolved oxygen [1]
- Oxygen levels fall → fish and other aquatic organisms suffocate [1]

(b) [4 marks]

Evaluate TWO methods used to conserve endangered species.

- Nature reserves: protect habitat from development/human interference [1] — limitation: may be too small / cannot prevent climate change [1]
- Captive breeding programmes: maintain populations and allow reintroduction [1] — limitation: animals may lose survival skills / reduced genetic diversity [1] — accept any two methods with benefit and limitation

(c) ★ [2 marks]

★ Explain why maintaining high biodiversity in an ecosystem is important for its stability.

- High biodiversity means more species filling similar ecological roles / more complex food webs [1]
- If one species is lost, others can fulfil the same role — ecosystem is more resilient to disruption [1]

Total for question 4: 10

Question 5 [10 marks]

This question is about genetics and inheritance.

(a) [3 marks]

Polydactyly is caused by a dominant allele (D). A heterozygous person (Dd) has children with a perso…

- dd (homozygous recessive) [1]
- Punnett square: Dd, Dd, dd, dd [1]
- 50% / 1 in 2 probability of polydactyly [1]

(b) [4 marks]

Describe how antibiotic resistance develops in bacteria through natural selection. Use the terms var…

- Random mutations create variation in bacterial population [1]

• Some mutations give bacteria resistance to the antibiotic [1]

• Non-resistant bacteria die when antibiotic is applied; resistant bacteria survive [1]

• Resistant bacteria reproduce and pass on resistance alleles to offspring (inheritance) [1]

(c) ★ [3 marks]

★ Explain how geographic isolation can lead to the formation of a new species (speciation).

• A geographical barrier (e.g. mountain, sea) prevents two populations from interbreeding [1]

• The two populations are subject to different selection pressures → different mutations selected for → populations diverge genetically [1]

• Over many generations, the populations become so different they can no longer interbreed to produce fertile offspring → new species [1]

Total for question 5: 10

Question 6 [7 marks]

(a) ★ [4 marks]

★ Describe the process of genetic engineering. Include in your answer the names and functions of th…

• The desired gene is identified and cut out from donor DNA using restriction enzymes [1]

• A bacterial plasmid (vector) is cut open with the same restriction enzyme, leaving complementary sticky ends [1]

• The gene is inserted into the plasmid; DNA ligase seals the joins, creating recombinant DNA [1]

• The recombinant plasmid is introduced into a host cell (e.g. bacterium) which then produces the desired protein [1]

(b) [3 marks]

Give ONE example of how genetic engineering has been used to benefit humans. Evaluate ONE advantage …

• Example: production of human insulin by bacteria [1]

• Advantage: safer/more effective than animal-derived insulin; large quantities can be produced [1]

• Concern: unknown long-term effects / ethical concerns about genetic modification of organisms [1]

Total for question 6: 7

Question 7 [6 marks]

(a) [6 marks]

"Human activity is the primary cause of current species extinction rates, which are far above the na…

• Human activities causing extinctions: habitat destruction (deforestation, urbanisation) [1]

• Pollution: eutrophication, plastic pollution, air quality reducing biodiversity [1]

• Climate change: human-caused warming shifts habitats, threatens species unable to adapt quickly [1]

• Overexploitation: overfishing, hunting — directly reducing populations below viable levels [1]

• Evidence: extinction rates estimated 100-1000× natural background; clearly linked to industrialisation and habitat loss [1]

• Counter-argument: natural events (volcanic eruptions, asteroid impacts) also cause extinction events; some modern extinctions predate industrial activity [1]

Note: For 5-6 marks: well-organised argument, evidence cited, at least one counter-argument considered, correct use of scientific vocabulary.

Total for question 7: 6
