



Ecosystems (Continuity and change) practice questions

24 questions • 76 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 76

Natural selection **Spec D4.1**

1 PAPER 1A STYLE [1 mark]

Which process generates new alleles?

- A. ☐ Mutation
- B. ☐ Crossing over
- C. ☐ Random orientation of bivalents
- D. ☐ Random fertilisation

2 PAPER 1A STYLE [1 mark]

Which is a density-independent selection pressure?

- A. ☐ Competition for nesting sites
- B. ☐ A very cold winter
- C. ☐ Predation by owls
- D. ☐ Spread of disease in a crowded population

3 PAPER 2A STYLE [2 marks]

A gardener grows a plant in rich, fertile soil and it grows very tall. Explain why its offspring will not inherit this extra height.

4 PAPER 1B STYLE

[6 marks]

In an experiment modelled on Endler's work, guppies were kept in replicate ponds with no predator, with the weak predator Rivulus, or with the strong predator Crenicichla. The table shows the mean number of coloured spots per male (practice data). (a) Calculate the percentage change in mean spots per male in the no-predator ponds from 0 to 14 months. [2] (b) Compare the results for Rivulus and Crenicichla ponds. [2] (c) Explain the trend in the Crenicichla ponds. [2]

Mean number of spots per male guppy			
Treatment	0 months	5 months	14 months
No predator	10.0	11.2	12.5
Rivulus	10.0	11.0	12.2
Crenicichla	10.0	9.1	8.4

5 PAPER 2B STYLE

[6 marks]

Explain how natural selection can lead to evolutionary change in a population.

6 PAPER 1A STYLE**[1 mark]****HL only**

After repeated use of an antibiotic, most bacteria in a hospital population are resistant to it. What type of selection is this?

- A. ☐ Artificial selection
- B. ☐ Sexual selection
- C. ☐ Natural selection
- D. ☐ Stabilizing selection

7 PAPER 2A STYLE**[3 marks]****HL only**

In a population in Hardy-Weinberg equilibrium, 16% of individuals show a recessive phenotype. Calculate the percentage of individuals that are heterozygous.

Answer =

8 PAPER 1B STYLE**[4 marks]****HL only**

A gene in a population of 1000 plants has two alleles, A and a. The table shows the observed genotypes (practice data). (a) Calculate the frequency of allele A. [1] (b) Calculate the expected number of heterozygotes if the population were in Hardy-Weinberg equilibrium. [1] (c) Compare the observed and expected numbers of heterozygotes and suggest which Hardy-Weinberg condition is not met. [2]

Observed genotypes			
Genotype	AA	Aa	aa
Number of plants	300	400	300

Answer =

Spec D4.2

[1 mark]

A. ☐ When only adult fish are caught

C. ☐ When the rate of harvesting is lower than the rate of replacement

10 PAPER 1A STYLE

[1 mark]

A. ☐ It stops light energy entering

C. ☐ It keeps the temperature constant

11 PAPER 2A STYLE

[5 marks]

Answer =

[illegible]

12

[4 marks]

The table shows DDT concentrations in an estuary food chain (practice data). (a) Calculate how many times greater the concentration is in the fish-eating birds than in the zooplankton. [1] (b) Explain the pattern shown in the data. [3]

DDT concentration	
Sample	DDT concentration / parts per million
Water	0.00005
Zooplankton	0.04
Small fish	0.5
Large fish	2.0
Fish-eating birds	25

Answer =

[illegible]

13

[6 marks]

Explain how the use of fertilizers on farmland can lead to the death of fish in a nearby lake.

[illegible]

14 PAPER 2A STYLE

[3 marks]

Outline the effects of plastic pollution on marine life.

15 PAPER 2A STYLE

[4 marks]

HL only

Using a named example, describe the changes that occur during primary succession.

16 PAPER 2A STYLE

[2 marks]

HL only

Explain how grazing by farm livestock can cause arrested succession.

Climate change Spec D4.3

17 PAPER 1A STYLE

[1 mark]

Which is an example of a positive feedback cycle in global warming?

- A. ☐ Increased photosynthesis by trees absorbs more CO₂
- B. ☐ Melting ice exposes darker surfaces that absorb more solar radiation
- C. ☐ Warmer oceans increase upwelling of nutrients
- D. ☐ More cloud reflects sunlight back into space

18 PAPER 1A STYLE

[1 mark]

What is the cause of coral bleaching?

- A. ☐ Ocean acidification dissolving coral skeletons
- B. ☐ Microplastics blocking coral polyps
- C. ☐ Increased water temperature causing corals to expel their symbiotic algae
- D. ☐ Reduced upwelling of nutrients

19

[5 marks]

The table shows the annual mean concentration of atmospheric carbon dioxide measured at Mauna Loa Observatory, Hawaii (values rounded to the nearest ppm). (a) Calculate the percentage increase in CO₂ concentration from 1960 to 2020. [2] (b) Compare the rate of increase between 1960–1980 and 2000–2020. [1] (c) Outline two anthropogenic causes of the increase. [2]

Annual mean atmospheric CO ₂ concentration at Mauna Loa (NOAA data)	
Year	CO ₂ concentration / ppm
1960	317
1980	339
2000	370
2020	414

Answer =

[illegible]

20

[3 marks]

Explain how early breakout of landfast ice threatens emperor penguins.

PAPER 2B STYLE

Explain how climate change could cause boreal forests to change from net carbon accumulation to net carbon loss.

[illegible]

PAPER 2A STYLE

Explain how warmer surface water can reduce energy flow through marine food chains.

[illegible]

PAPER 2A STYLE

Using the example of great tits and caterpillars in north European forests, explain how climate change can disrupt the synchrony of phenological events.

[illegible]

HL only

Explain how reduced snow cover has caused evolution in the tawny owl (*Strix aluco*).

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

A A [1]

2. [1]

B B [1]

3. [2]

- height was acquired due to an environmental factor / soil, not genes [1]
- acquired characteristics are not encoded in the base sequence of genes / DNA of gametes [1]
- so they cannot be passed on / only heritable traits can evolve [1]
- max 2

4. [6]

- (a) $(12.5 - 10.0) \div 10.0 \times 100$ [1]
- (a) +25% / increase of 25% [1]
- (b) Rivulus: spots increased (10.0 to 12.2) whereas Crenicichla: spots decreased (10.0 to 8.4) [1]
- (b) both start at the same value / both change in the same time / difference grows with time [1]
- (c) brightly coloured males are more conspicuous / more likely to be eaten by Crenicichla [1]
- (c) males with fewer spots survive and reproduce more, passing on alleles for fewer spots [1]
- (c) predation outweighs sexual selection / female preference for colourful males OWTTE [1]
- max 6

5. [6]

- variation exists between individuals in a population [1]
- mutation generates new alleles [1]
- sexual reproduction / meiosis and fertilisation generate new combinations of alleles [1]
- more offspring are produced than the environment can support / overproduction [1]
- population exceeds carrying capacity so there is competition for limited resources, e.g. food [1]
- selection pressures, e.g. predation / extreme temperature, affect individuals differently [1]
- better-adapted individuals / those with higher fitness survive and reproduce more [1]
- they pass on alleles for the favourable traits to offspring [1]
- only heritable traits / not acquired characteristics are passed on [1]
- over many generations the frequency of the favourable trait / allele increases [1]
- max 6

6. [1] **HL only**

C C [1]

7. [3] **HL only**

- $q^2 = 0.16$ so $q = 0.4$ [1]
- $p = 1 - 0.4 = 0.6$ [1]
- $2pq = 2 \times 0.6 \times 0.4 = 0.48$, so 48% [1]
- Allow ECF from an incorrect value of q

8. [4] HL only

- (a) $p = (2 \times 300 + 400) \div 2000 = 0.5$ [1]
- (b) $2pq = 2 \times 0.5 \times 0.5 = 0.5$, so 500 heterozygotes expected [1] Allow ECF
- (c) fewer heterozygotes observed (400) than expected (500) [1]
- (c) mating is non-random, e.g. self-pollination / similar plants mating / survival of heterozygotes is lower [1]
- (c) Accept population divided / not a single interbreeding population OWTTE

9. [1]

C C [1]

10. [1]

B B [1]

11. [5]

- (a) $(442\,000 - 520\,000) \div 520\,000 \times 100$ [1]
- (a) -15% / decrease of 15% [1]
- (b) fewer trees so less transpiration / less water vapour released into the atmosphere [1]
- (b) less evaporative cooling / less driving of air flows that bring in moist air [1]
- (b) water vapour from transpiration normally condenses and falls as rain further inland / water is recycled [1]
- (b) longer dry season / drought stress / more fires reduce forest further (positive feedback) [1]
- max 5

12. [4]

- (a) $25 \div 0.04 = 625$ times [1]
- (b) concentration increases at each higher trophic level / biomagnification [1]
- (b) DDT is persistent / not broken down [1]
- (b) DDT is fat-soluble / stored in fatty tissue / not excreted [1]
- (b) each consumer eats many organisms from the level below, taking in all their DDT [1]
- max 4

13. [6]

- nitrate / phosphate fertilizers leach from soil (into the lake) [1]
- nutrient enrichment of the water is eutrophication [1]
- rapid growth of algae / algal bloom [1]
- algae block light so plants below cannot photosynthesise and die [1]
- algae / plants die and are decomposed by bacteria [1]
- decomposers respire aerobically / use oxygen [1]
- biochemical oxygen demand / BOD increases [1]
- dissolved oxygen concentration falls / water becomes hypoxic [1]
- fish cannot respire aerobically and die [1]
- Do not accept 'algae use up oxygen by photosynthesis'
- max 6

14. [3]

- plastics are non-biodegradable / persist for a long time [1]
- macroplastic / nets / bags cause entanglement, e.g. of seals / turtles / seabirds [1]
- macroplastic swallowed, e.g. bags mistaken for jellyfish by turtles, blocking the gut / starvation [1]
- microplastics eaten by zooplankton / filter feeders / fish [1]
- microplastics pass along food chains / carry toxic chemicals [1]
- max 3

15. [4] HL only

- named example, e.g. sand dunes / land exposed by a retreating glacier / volcanic island [1]
- pioneer species colonise bare ground / sand with no soil [1]
- organisms change conditions, e.g. add humus / form soil / stabilise sand, allowing new species to colonise [1]
- plants increase in size, e.g. grasses to shrubs to trees [1]
- primary production increases [1]
- species diversity increases [1]
- food webs become more complex [1]
- nutrient cycling increases [1]
- max 4

16. [2] HL only

- livestock eat / trample tree seedlings / young shrubs [1]
- so woodland cannot develop and grassland / moorland persists [1]
- community is prevented from reaching the climax community / plagioclimax [1]
- max 2

17. [1]

B B [1]

18. [1]

C C [1]

19. [5]

- (a) $(414 - 317) \div 317 \times 100$ [1]
- (a) 30.6% / 31% [1]
- (b) rate doubled / 22 ppm per 20 years in 1960–1980 compared with 44 ppm per 20 years in 2000–2020 [1]
- (c) combustion of fossil fuels, e.g. coal / oil / natural gas [1]
- (c) deforestation / burning of forests, reducing CO₂ uptake and releasing CO₂ [1]
- (c) cement production [1]
- max 5

20. [3]

- emperor penguins breed on landfast ice / ice attached to the coast [1]
- chicks need stable ice until they have grown waterproof feathers [1]
- early breakout causes chicks to drown / die of cold [1]
- breeding grounds lost / breeding fails / population falls [1]
- max 3

21. [6]

- boreal forests / taiga currently store more carbon than they release / carbon sink [1]
- warmer temperatures [1]
- decreased winter snowfall / less spring meltwater [1]
- increased incidence of drought [1]
- reduced primary production / less photosynthesis so less CO₂ absorbed [1]
- forest browning / trees die [1]
- more frequent and intense forest fires [1]
- combustion of legacy carbon / old soil organic matter releases CO₂ [1]
- positive feedback: released CO₂ causes further warming [1]
- this is a tipping point / change becomes self-sustaining OWTTE [1]
- max 6

22. [3]

- warm surface water forms a stable layer that does not mix with deeper water [1]
- prevents upwelling of nutrients / nitrate / phosphate to the surface [1]
- phytoplankton growth / ocean primary production decreases [1]
- less energy available to consumers such as fish / seabirds [1]
- max 3

23. [4] HL only

- phenology is the timing of biological events [1]
- caterpillar emergence / peak biomass is cued by temperature / leaf budburst [1]
- great tit breeding / laying date relies partly on photoperiod / changes less [1]
- warmer springs make caterpillar peak earlier [1]
- chicks hatch after the peak food supply / mismatch [1]
- fewer chicks survive / lower breeding success [1]
- max 4

24. [3] HL only

- tawny owls have heritable grey and brown colour variants [1]
- grey owls had higher survival / fitness in snowy winters (better camouflaged) [1]
- with less snow, brown owls have higher fitness than before / survive and reproduce more [1]
- frequency of brown owls / allele for brown colour increases in the population [1]
- max 3