



## Natural selection: practice questions

8 questions • 24 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 ..... / 24

**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

**[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       |

[illegible]

## 5

**[6 marks]**

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

[illegible]

**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 = .....

---

---

---

---

---

---

---

---

# 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