



Populations and communities: practice questions

8 questions • 28 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 / 28

1 PAPER 1A STYLE [1 mark]

In a capture-mark-release-recapture study, 40 snails were caught, marked and released. In a second sample of 50 snails, 10 were marked. What is the estimated population size?

- A. ☐ 100
- B. ☐ 200
- C. ☐ 500
- D. ☐ 2000

2 PAPER 1A STYLE [1 mark]

Which of the following is an example of allelopathy?

- A. ☐ A fungus secreting a chemical that kills bacteria around it
- B. ☐ A tree releasing a chemical from its roots that inhibits the growth of other plants nearby
- C. ☐ Bacteria in root nodules fixing nitrogen for a legume
- D. ☐ A plant producing toxins in its leaves that deter herbivores

3 PAPER 1A STYLE [1 mark]

What do hard corals obtain from the zooxanthellae living in their cells?

- A. ☐ Carbon dioxide and ammonia
- B. ☐ Fixed nitrogen from the atmosphere
- C. ☐ Sugars and other products of photosynthesis
- D. ☐ Protection from predators

Students estimated the population of dandelion plants on a school field of area 600 m². They placed ten 1 m² quadrats at random coordinates and counted the dandelions in each. (a) Calculate the mean number of dandelions per quadrat. [1] (b) Estimate the population size on the field. [1] (c) The standard deviation of the counts is 2.6. State what this indicates about the distribution of the dandelions. [1] (d) Explain why the quadrats were placed at random coordinates. [2]

Number of dandelion plants per 1 m ² quadrat										
Quadrat	1	2	3	4	5	6	7	8	9	10
Dandelions	4	7	2	0	5	8	3	6	1	4

Answer =

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5 PAPER 1B STYLE

[6 marks]

An ecologist recorded the presence or absence of two moss species, X and Y, in 60 random quadrats on a woodland floor. (a) State a null hypothesis for a chi-squared test on these data. [1] (b) Calculate the expected number of quadrats with both species present. [1] (c) The chi-squared value for the data is 10.0. The critical value at $p = 0.05$ with 1 degree of freedom is 3.84. Deduce what the result shows about the two species. [2] (d) Suggest why this result does not prove that the two species compete, and outline one way to test the hypothesis of competition. [2]

Presence and absence of moss species X and Y in 60 quadrats			
	Y present	Y absent	Total
X present	6	24	30
X absent	18	12	30
Total	24	36	60

Answer =

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6 PAPER 2A STYLE

[3 marks]

Outline how both partners benefit in the mutualistic relationship between plants of the family Fabaceae and the bacteria in their root nodules.

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7 PAPER 2A STYLE

[4 marks]

Duckweed plants were grown in a beaker of pond water and the number of fronds counted every three days. The numbers rose slowly, then very rapidly, then levelled off.

- (a) Explain the reasons for the rapid increase in the early part of the experiment. [2] (b) Suggest two factors that caused the numbers to level off. [2]

8 PAPER 2B STYLE

[7 marks]

Explain how density-dependent factors control the size of animal populations, using a predator-prey relationship as an example.

Mark scheme

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

1. [1]

B B [1]: $(40 \times 50) \div 10 = 200$

2. [1]

B B [1]. A is antibiotic secretion; C is mutualism; D is a defence against herbivory, not against competing plants.

3. [1]

C C [1]. A is what the zooxanthellae receive from the coral.

4. [5]

- (a) $40 \div 10 = 4.0$ (dandelions per quadrat / per m^2) [1]
- (b) $4.0 \times 600 = 2400$ dandelions [1] ECF from (a)
- (c) the counts vary widely around the mean / the dandelions are unevenly spread / clumped OWTTE [1]
- (d) to avoid (sampler) bias / so every part of the field has an equal chance of being sampled [1]
- (d) so the sample is representative / the estimate is closer to the true population size / reduces sampling error [1]

5. [6]

- (a) there is no association between the distributions of species X and Y / the two species are distributed independently [1]
- (b) $30 \times 24 \div 60 = 12$ [1]
- (c) $10.0 > 3.84$, so the null hypothesis is rejected / the association is significant [1]
- (c) negative association: the species occur together less often than expected (6 observed, 12 expected) [1]
- (d) association/correlation does not show cause / the species may need different conditions (e.g. light, moisture, soil pH) OWTTE [1]
- (d) remove one species from some plots and compare growth/abundance of the other with control plots / grow them alone and together in the laboratory [1]

6. [3]

- bacteria / *Rhizobium* fix nitrogen (gas) / convert N_2 to ammonia/ammonium [1]
- plant uses fixed nitrogen to make amino acids/proteins/nucleic acids / can grow in nitrogen-poor soil [1]
- bacteria receive sugars/carbon compounds/products of photosynthesis from the plant [1]
- bacteria gain a protected / low-oxygen environment in the nodule [1]
- max 3

7. [4]

- (a) resources (light, mineral ions, space) are plentiful / little competition [1]
- (a) birth/reproduction rate greatly exceeds death rate [1]
- (a) no/few pathogens/pests/consumers in the beaker [1]
- (b) competition for light as the surface becomes covered / shading [1]
- (b) mineral ions (e.g. nitrate/phosphate) in the water used up [1]
- (b) carrying capacity of the beaker reached / space on the water surface limited [1]
- max 4

8. [7]

- density-dependent factors have a greater effect as population density increases [1]
- they act by negative feedback / push the population back towards the carrying capacity [1]
- competition for limited resources (food, space) increases in dense populations [1]
- pathogens / pests / parasites are transferred more easily in dense populations [1]
- dense prey populations are easier for predators to find/catch [1]
- named real example, e.g. Canada lynx and snowshoe hare [1]
- more prey → more predators survive and breed → predator numbers rise [1]
- increased predation reduces prey numbers [1]
- fewer prey → predators starve / breed less → predator numbers fall [1]
- prey numbers then recover / cycles repeat with predator peaks lagging behind prey peaks [1]
- this is top-down control; bottom-up control by food supply may also act [1]
- density-independent factors (e.g. weather) cause fluctuations but do not regulate [1]
- max 7