# Organisms and Populations

Standard difficulty · 20 questions · 40 marks · Time: 42 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

## Section A — Choose the correct answer — 8 × 1 = 8 marks

**1.** The interaction in which one species benefits and the other is unaffected is:
**(a)** amensalism **(b)** parasitism **(c)** mutualism **(d)** commensalism

**2.** The relationship in the sea anemone and the clown fish is:
**(a)** commensalism **(b)** amensalism **(c)** competition **(d)** predation

**3.** Which adaptation is shown by plants with CAM photosynthesis?
**(a)** Diapause, a stage of suspended development in unfavourable conditions
**(b)** A thick cuticle and stomata sunk in deep pits, which reduce water loss
**(c)** Getting water by oxidising its internal fat, and excreting very concentrated urine
**(d)** Stomata kept closed during the day

**4.** A pond had 160 lotus plants last year, and 2 new plants were added by reproduction this year. The birth rate is:
**(a)** 0.0125 per lotus per year **(b)** 80 per lotus per year
**(c)** 0.0123 per lotus per year **(d)** 0.2 per lotus per year

**5.** A field of 20 $m^2$ has 160 Parthenium plants. The population density is:
**(a)** 8 per $m^2$ **(b)** 0.125 per $m^2$ **(c)** 80 per $m^2$ **(d)** 3,200 per $m^2$

**6.** In logistic growth, $dN/dt = rN(K - N)/K$. If $r = 0.5$ per year, $K = 4{,}000$ and $N = 3{,}000$, $dN/dt$ is:
**(a)** 2,000 per year **(b)** 1,500 per year **(c)** 500 per year **(d)** 375 per year

**7.** A population of 210 has 40 births, 17 immigrants, 23 deaths and 9 emigrants in a year. Its size at the end of the year is:
**(a)** 299 **(b)** 227 **(c)** 235 **(d)** 219

**8.** Assertion (A): The relationship in a lichen (a fungus and an alga) is an example of mutualism.
Reason (R): In every interaction between two species, both species are harmed.
**(a)** Both A and R are true, and R is the correct explanation of A.
**(b)** Both A and R are true, but R is not the correct explanation of A.
**(c)** A is true, but R is false.
**(d)** A is false, but R is true.

## Section B — Short answer — 8 × 2 = 16 marks

**9.** Distinguish between regulators and conformers.

**10.** (a) In a laboratory population of 150 fruit flies, 30 die in a week. Find the death rate. (b) 75 lotus plants gave 6 new plants in a year. Find the birth rate.

**11.** A deer population of 710 has 80 births, 60 deaths, 31 immigrants and 7 emigrants in a year. What is its size after one year? Is it growing or shrinking?

**12.** A population grows logistically with r = 0.4 per year and carrying capacity K = 2,000. Find dN/dt when N = 1,600, and when N = K. What would dN/dt be at N = 1,600 with unlimited resources?

**13.** Name the interaction, and its signs (+, − or 0) for the two species, in (i) the cactus-feeding moth that brought Opuntia under control in Australia and (ii) flamingoes and resident fishes competing for zooplankton in South American lakes.

**14.** How are these adapted: (i) bears; (ii) mammals of cold climates (Allen’s rule)?

**15.** In a population, 34% are pre-reproductive, 48% reproductive and 18% post-reproductive. What shape will its age pyramid have, and is the population expanding, stable or declining?

**16.** Five 1 $m^2$ quadrats in a 500 $m^2$ meadow contain 10, 10, 2, 11, 5 plants of one species. Estimate the density and the total population.

## Section C — Word problems — 4 × 4 = 16 marks

**17.** Describe the ways organisms respond to stressful abiotic conditions.

**18.** Compare exponential and logistic growth, with their equations and curves. For a population with r = 0.5 per year and K = 1,000, find the growth rate at N = 200 under each model. Which is more realistic, and why?

**19.** A population of 760 rabbits has 19 births, 38 deaths, 39 immigrants and 30 emigrants in a year. Find (a) the birth rate, (b) the death rate, (c) the population after a year. Name two other attributes of a population that an individual does not have.

**20.** Explain commensalism, predation, mutualism with their signs for the two species, using these examples: an orchid growing on a mango branch; the cactus-feeding moth that brought Opuntia under control in Australia; the Mediterranean orchid Ophrys and the bee that pollinates it.

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# Answer key

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| Q | Answer | Working |
|---|---|---|
| 1 | **(d) commensalism** | — |
| 2 | **(a) commensalism** | signs: + and 0 |
| 3 | **(d) Stomata kept closed during the day** | — |
| 4 | **(a) 0.0125 per lotus per year** | 2 ÷ 160 |
| 5 | **(a) 8 per $m^2$** | 160 ÷ 20 |
| 6 | **(d) 375 per year** | 0.5 × 3,000 × 1,000/4,000 |
| 7 | **(c) 235** | $N_{t+1} = N_t + (B + I) - (D + E)$ |
| 8 | **(c) A is true, but R is false.** | A is true: it is mutualism (+ and +). R is false. |
| 9 | **Regulators maintain homeostasis by physiological and behavioural means, as birds and mammals keep a constant body temperature. Conformers cannot; their body temperature or osmotic concentration changes with the surroundings.** | — |
| 10 | **(a) 0.2 per fly per week; (b) 0.08 per lotus per year** | 30 ÷ 150; 6 ÷ 75 |
| 11 | **754; growing** | $N_{t+1} = N_t + (B + I) - (D + E)$ |
| 12 | **128 per year; 0 per year; 640 per year (exponential, dN/dt = rN)** | dN/dt = rN(K − N)/K |
| 13 | **(i) predation, + and −; (ii) competition, − and −** | — |
| 14 | **(i) Hibernation, to escape the winter cold; (ii) shorter ears and limbs, which reduce heat loss** | — |
| 15 | **Bell-shaped; stable** | the young about equal the reproductive group |
| 16 | **7.6 per $m^2$; about 3,800 plants** | mean = 38 ÷ 5; total = mean × 500 |
| 17 | **Regulate: maintain homeostasis physiologically, as mammals keep body temperature constant by sweating or shivering. Conform: let the body change with the surroundings, as most animals and plants do. Migrate: move temporarily to a better area, as Siberian birds come to Bharatpur in winter. Suspend: bacteria, fungi and lower plants form thick-walled spores; seeds become dormant; bears hibernate; snails and** | — |

| Q | Answer | Working |
|---|---|---|
| | **fish aestivate; zooplankton enter diapause.** | |
| 18 | **Exponential: dN/dt = rN, with unlimited resources; the J-shaped curve. Logistic: dN/dt = rN(K − N)/K; growth slows as N approaches the carrying capacity K; the sigmoid (S-shaped) curve. At N = 200: exponential 100 per year, logistic 80 per year. Logistic is more realistic because resources are always limited** | — |
| 19 | **(a) 0.025 per rabbit per year; (b) 0.05 per rabbit per year; (c) 750. Other attributes: sex ratio and age distribution (age pyramid), also population density** | 19 ÷ 760; 38 ÷ 760; 760 + (19 + 39) − (38 + 30) |
| 20 | **Commensalism (+ and 0): an orchid growing on a mango branch. Predation (+ and −): the cactus-feeding moth that brought Opuntia under control in Australia. Mutualism (+ and +): the Mediterranean orchid Ophrys and the bee that pollinates it. In mutualism both gain; in commensalism one gains and the other is unaffected; in parasitism and predation one gains at the other's cost; in competition both lose** | — |