



Biology Higher level Paper 2

12 May 2026

Zone A afternoon | Zone B morning | Zone C afternoon

Candidate name

2 hours 30 minutes

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Instructions to candidates

- Write your candidate name in the boxes above.
- Do not open this mock examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.

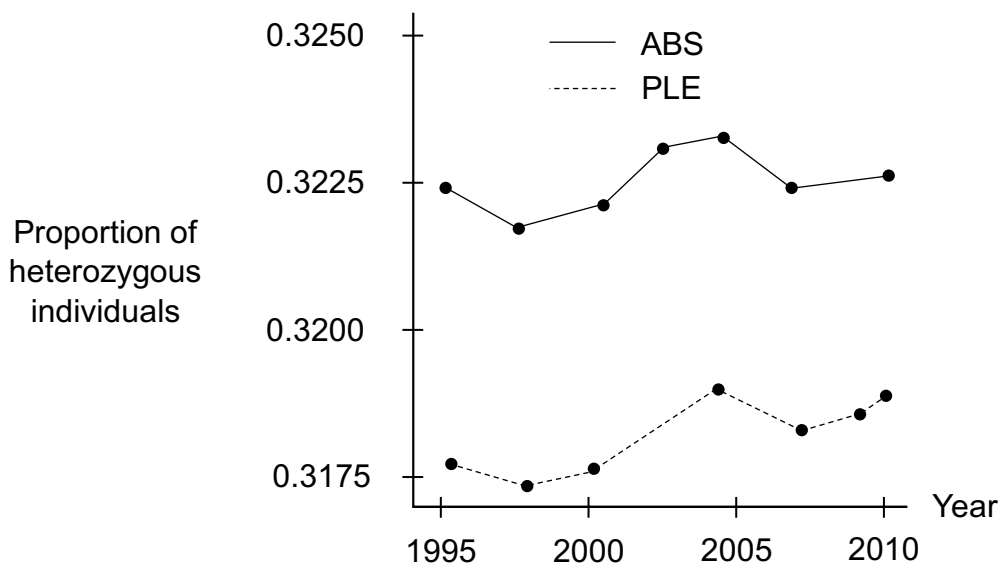
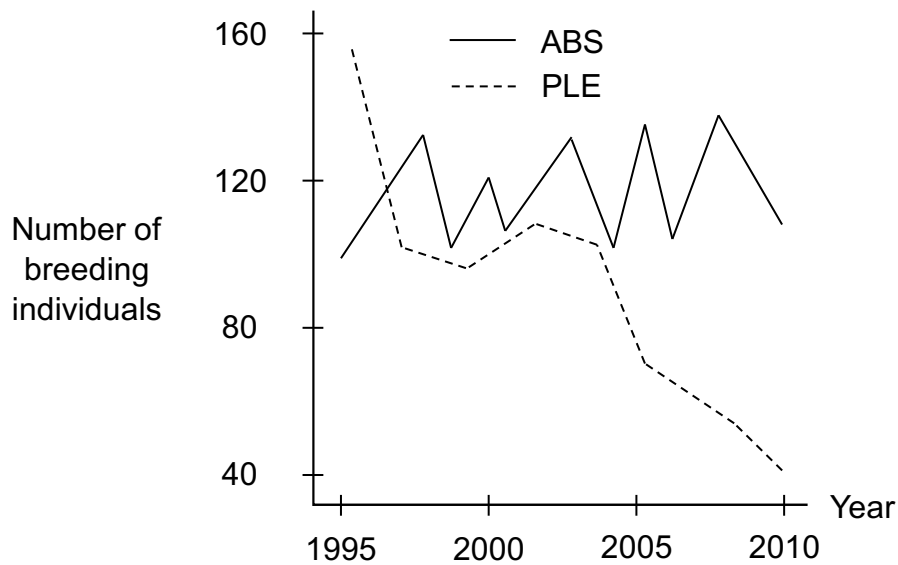


Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Understanding the demographic and genetic consequences of declining populations is essential for their conservation. A study was done on two subpopulations of Florida scrub jay birds (*Aphelocoma coerulescens*) with different demographic trajectories. The subpopulation at the Archbold Biological Station (ABS) is under protection and management, and the one near Placid Lakes Estates (PLE) is experiencing suburban development. Both subpopulations are within migratory distance from each other.

Researchers measured the number of breeding individuals and the proportion of heterozygous individuals within both subpopulations.



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(Question 1 continued)

- (a) The number of breeding individuals can be used as an estimate of population size. Explain the shape of the curves for each subpopulation. [2]

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- (b) Compare and contrast the proportion of heterozygous individuals between ABS and PLE subpopulations. [2]

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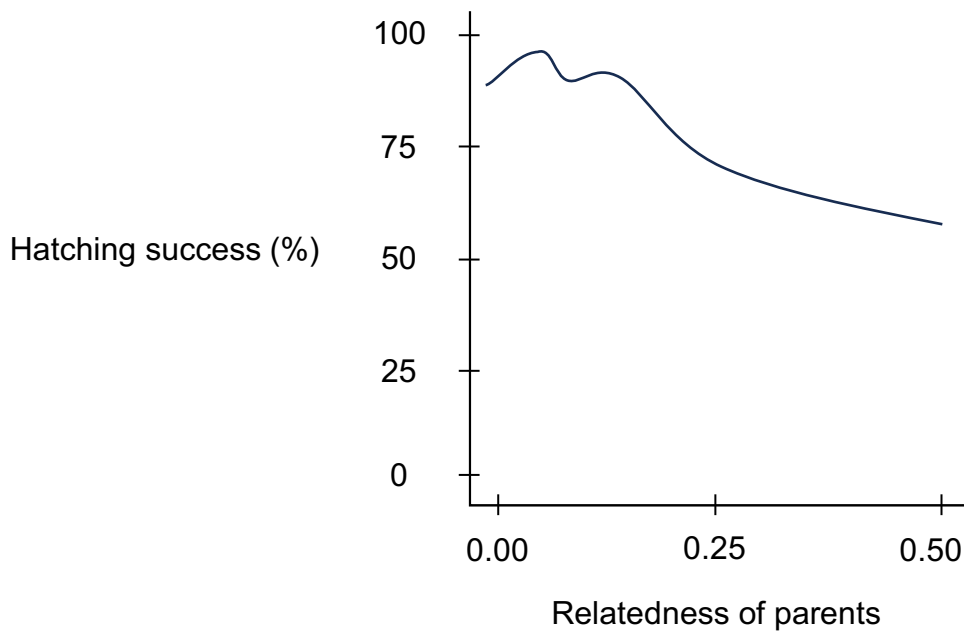
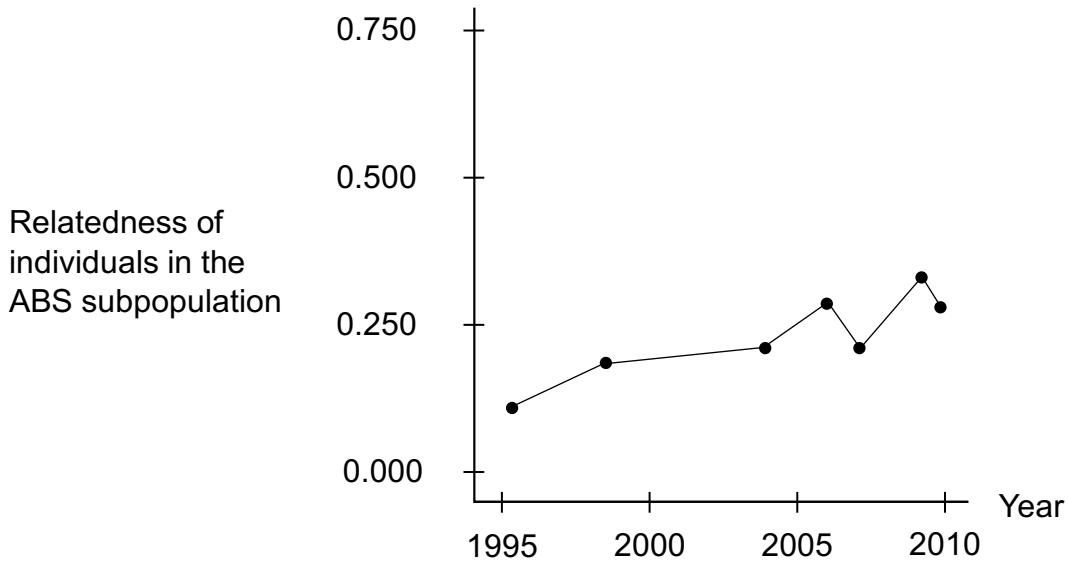
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Turn over



(Question 1 continued)

The researchers investigated the effects of these genetic changes on the fitness of the ABS offspring by measuring the relatedness of individuals in the subpopulation. They also determined the hatching success of laid eggs in ABS birds based on how related the parents are to each other.



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(Question 1 continued)

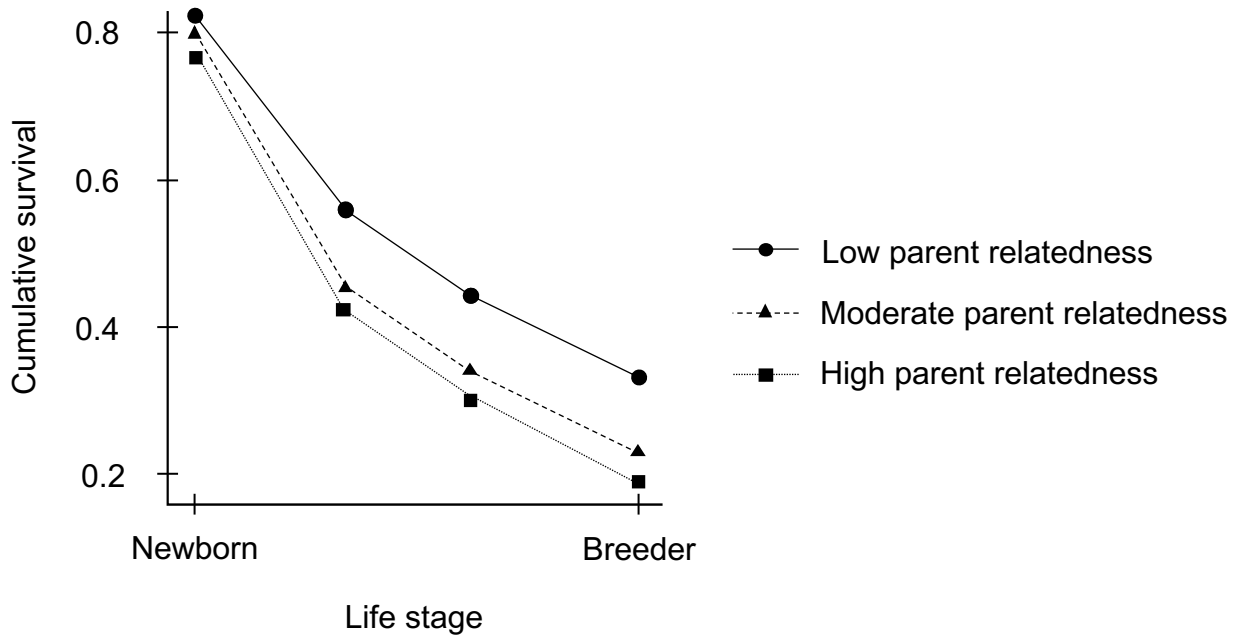
(c) Suggest a reason for the trend observed in the relatedness of ABS birds. [1]

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(d) Calculate the difference in hatching success between parents with a relatedness of 0.50 and parents who are not related. [1]

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The survival of the ABS offspring during their lifetime (cumulative survival) was investigated according to how related their parents are to each other.



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(Question 1 continued)

- (e) Explain the relationship between the relatedness of parents and the cumulative survival of the offspring.

[2]

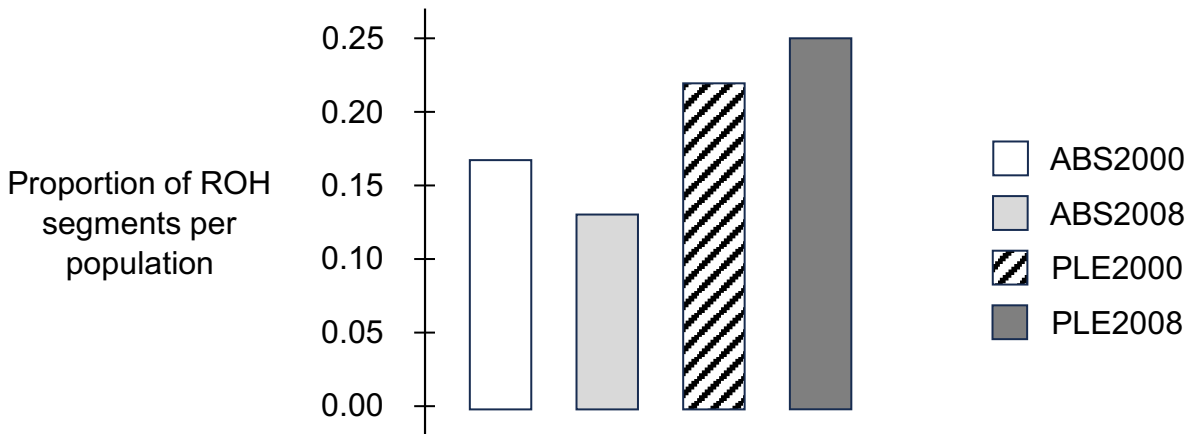
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The researchers studied the genetic structure of both subpopulations by examining 11,737 single nucleotide polymorphisms (SNPs). If there are many consecutive SNPs that are identical in both paternal and maternal chromosomes, they are recorded as runs of homozygosity (ROH). The graph shows the proportion of ROH segments in ABS and PLE populations in 2000 and 2008.



- (f) Calculate the percentage difference in proportion of ROH segments between ABS and PLE birds in 2008.

[1]

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(Question 1 continued)

(g) Explain the trends in ROH data within and between the populations. [2]

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(h) Using all the information presented, discuss the interplay between demographic and genetic factors in driving population declines. [3]

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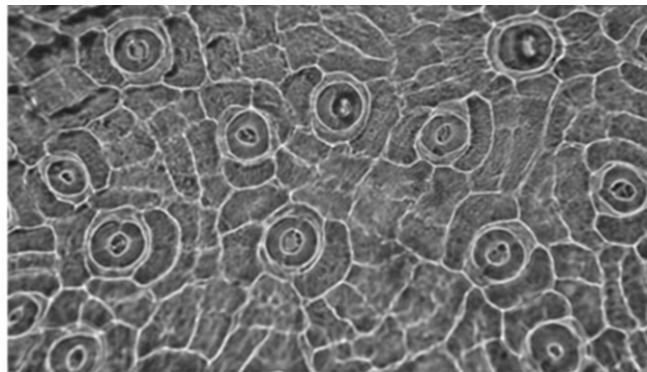
(i) Evaluate whether or not it is worthwhile to fund conservation efforts for the PLE subpopulation. [1]

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2. The image shows a microscopic leaf section.



(a) Calculate the stomatal density with a field view area of 0.15 mm^2 . [1]

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(b) Explain how plants transport water in xylem when stomata are closed. [2]

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(c) Alveoli and stomata both allow for the transport of gases in and out of organisms. Compare and contrast how they function. [2]

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(Question 2 continued)

- (d) Transport of nutrients in human blood needs to be regulated. Describe how the Bohr shift enhances O₂ delivery to actively respiring muscle tissue. [2]

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3. The development of cells and organisms across their lifetimes is a complex process.

(a) List **two** stem cell niches. [1]

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(b) Explain how embryonic stem cells develop specific functions. [2]

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(c) Compare and contrast how the human uterus and plant ovary support the stages of embryo development. [2]

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(Question 3 continued)

- (d) Outline how the developmental changes of puberty are controlled by gonadotropin-releasing hormone (GnRH) and steroid sex hormones.

[3]

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4. Cells communicate with each other in many ways.

(a) State the role of cytokines in the human body. [1]

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(b) Outline the signal transduction involved in cells that respond to insulin. [2]

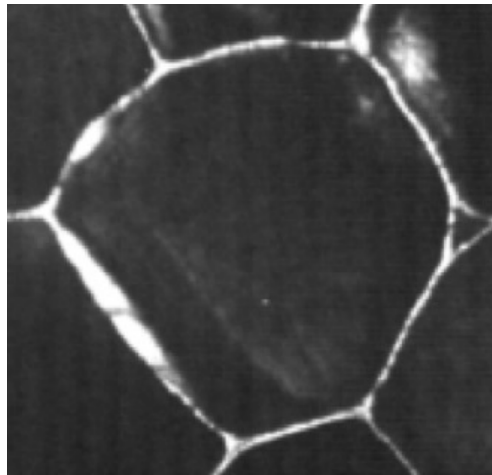
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(c) Describe the activity cycle of G-proteins in chemical signalling. [3]

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5. A potato cell is shown in the micrograph.



(a) The cell's Ψ_s is -450kPa and its Ψ_p is 300kPa . Calculate Ψ . [1]

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(b) The cell is transferred to a glucose solution with $\Psi_s = -400\text{kPa}$. State, with a reason, the direction of water flow. [1]

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(c) The original potato the cell was extracted from is allowed to sit in open air to dry. Explain what would happen to the water potential of the potato cells. [2]

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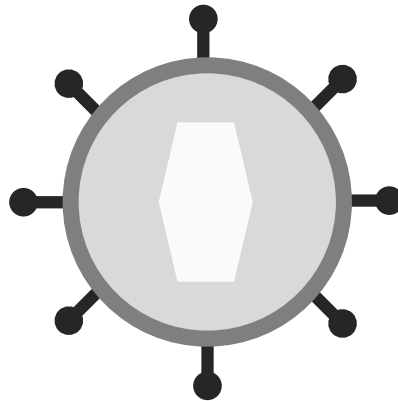
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6. The image shows a type of virus that can infect humans.



(a) State **two** structural features common to all viruses. [1]

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(b) The virus causes the death of cells in the ascending Loop of Henle. Outline the impact this may have on the nephron's function. [2]

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(c) A symptom of viral kidney infections is pyuria, in which higher than normal white blood cell levels are found in urine. Suggest how this might occur. [1]

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7. Ecosystems, communities, and populations are all dynamic entities.

(a) Distinguish between primary and secondary succession. [1]

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(b) Explain, using **one** example, how climate change can disrupt synchrony of phenological events. [2]

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(c) Outline how climate-induced phenological shifts can cause secondary succession. [2]

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(d) State, with a reason, **one** assumption of the Hardy Weinberg equation that could be violated during secondary succession. [1]

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Section B

Answer **two** questions. One additional mark is available for the construction of your answers for each question. Answers must be written within the answer boxes provided.

- 8.** Diversity in organisms is reflected in their functions.
- (a) Electron transfers are important processes in all organisms. Discuss the source, movement, and role of electrons in photosynthesis and respiration. [7]
 - (b) Compare and contrast the male reproductive system in humans and plants. [4]
 - (c) Outline how adaptive radiation can lead to different types of biodiversity. [4]
- 9.** Interactions between components of living organisms are essential to their viability.
- (a) Describe the role of proteins in the adaptations of muscles, alveoli, and gametes. [7]
 - (b) Outline the consequences of auxin and cytokinin interactions. [4]
 - (c) Explain how John Endler’s experiments with guppies demonstrate the role of natural and sexual selection in evolution. [4]
- 10.** Change is present at every level of biological organization.
- (a) Explain why some mutations are more harmful than others. [4]
 - (b) “Cladograms are hypotheses, not facts.” Discuss this statement with reference to convergent evolution. [4]
 - (c) Explain the role of metabolic reactions in energy flow within ecosystems. [7]



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References:

1. Chen et al., 2016, *Current Biology* 26, 2974–2979. November 7, 2016 Elsevier Ltd.
<http://dx.doi.org/10.1016/j.cub.2016.08.062>
Nguyen, T. N., Chen, N., Cosgrove, E. J., Bowman, R., Fitzpatrick, J. W., & Clark, A. G. (2022). Dynamics of reduced genetic diversity in increasingly fragmented populations of Florida scrub jays, *Aphelocoma coerulescens*. *Evolutionary Applications*, 15, 1018–1027. <https://doi.org/10.1111/eva.13421>
2. Wakefield, S.; Topp, B.; Alam, M. Crown Position and Rootstock Genotype Influence Leaf Stomatal Density in *Macadamia* sp. *Biol. Life Sci. Forum* 2022, 11, 9. <https://doi.org/10.3390/IECPS2021-11922>
3. Gancarz, Marek. “Correlation Between Cell Size and Blackspot of Potato Tuber Parenchyma Tissue After Storage.” *Postharvest Biology and Technology*, vol. 117, Mar. 2016, pp. 161–67.
<https://doi.org/10.1016/j.postharvbio.2016.03.004>.

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