



Biology

Higher Level

Paper 2 — Mock Examination

Mock Exam 1

Calculator required

Time allowed: **2 hours 30 minutes**

Maximum mark: **80 marks**

Candidate information

Candidate name:

Session number:

Date:

Topic emphasis: unity and diversity of cells and organisms, form and function in cells, organisms and ecosystems, interaction and interdependence at the levels of molecules, cells and ecosystems, and continuity and change including inheritance, evolution and the interpretation of biological data.

Instructions to candidates

- Write your session number in the box on the cover.
- Do not open this examination paper until you are told 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]**.

The mark allocation is shown in square brackets at the end of each question or part question. Where a numerical answer is required, working should be shown and the answer given to an appropriate number of significant figures. In Section B, **one additional mark** is available for each question for the construction of your answer: this mark is awarded when the answer is clear enough to be understood without re-reading and when the question has been answered succinctly, with little or no repetition or irrelevant material.

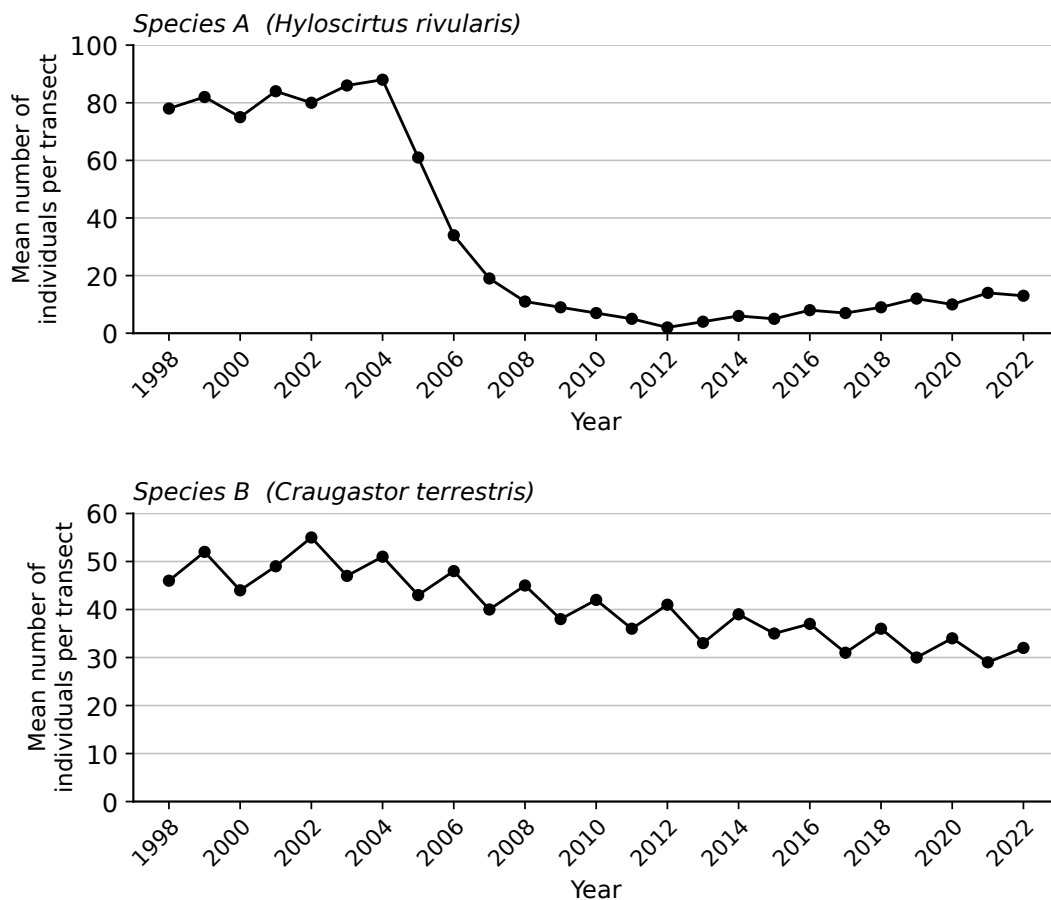
Mark allocation

Section A (questions 1–7)	[48 marks]
Section B (questions 8–10; answer two questions)	[32 marks]
Total	[80 marks]

Section A

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

1. The amphibian chytrid fungus *Batrachochytrium dendrobatidis* (Bd) infects the keratin-containing outer layers of frog skin. Infection disrupts gas exchange and the movement of ions across the skin. Between 1998 and 2022, biologists recorded the number of frogs seen along fixed transects in a mountainous region of Central America. Species A breeds in fast-flowing streams and species B lives in the leaf litter of the forest floor. The graphs show the mean number of individuals recorded per transect in each year.



(This question continues on the following page)

(Question 1 continued)

- (a)** State the year in which the lowest mean number of individuals of species A was recorded. **[1]**

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- (b)** Compare and contrast the changes in the mean number of individuals recorded for the two species between 1998 and 2022. **[3]**

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- (c)** Calculate the percentage decrease in the mean number of individuals of species A between 2004 and 2008. **[1]**

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- (d)** Suggest **two** limitations of using transect counts of adult frogs to estimate the size of a frog population. **[2]**

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(This question continues on the following page)

(Question 1 continued)

Frogs were captured, swabbed and released at sites throughout the region between 2005 and 2010. The table shows the number of individuals of six species that tested positive for Bd.

Species	Number of frogs sampled	Number infected with Bd	% infected	Main habitat
<i>Hyloscirtus rivularis</i> (species A)	1240	806	65.0	fast-flowing streams
<i>Craugastor terrestris</i> (species B)	1685	371	22.0	forest leaf litter
<i>Atelopus varius</i>	342	253	74.0	stream banks
<i>Smilisca phaeota</i>	918	138	15.0	temporary ponds
<i>Bolitoglossa colonnea</i>	205	21	10.2	bromeliads in trees
<i>Rhinella horribilis</i>	1104	122	11.1	open ground

(e) State which species had the greatest percentage of individuals infected with Bd.

[1]

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(f) Suggest **one** reason for the difference between the percentages of each species infected with Bd.

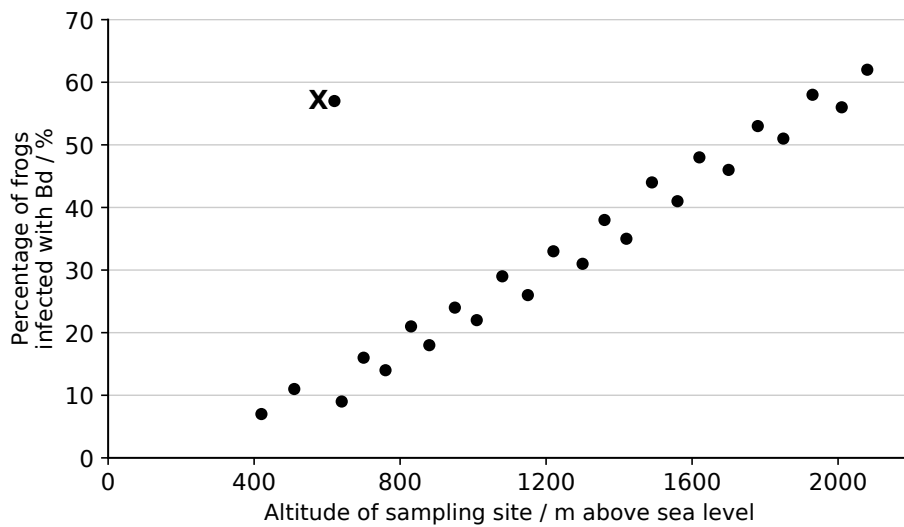
[1]

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(This question continues on the following page)

(Question 1 continued)

Bd grows best at temperatures between 17 °C and 25 °C. The graph shows the altitude of each sampling site and the percentage of frogs at that site infected with Bd.



- (g) State the relationship between the altitude of a sampling site and the percentage of frogs infected with Bd. [1]

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- (h) A student suggested that the point labelled **X** is atypical. Outline a reason for this suggestion. [1]

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- (i) Evaluate the hypothesis that infection with Bd is the main cause of the decline of amphibian populations in this region. [3]

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2. Enzymes are globular proteins that catalyse the reactions of metabolism.

- (a)** Outline the induced-fit model of enzyme–substrate interaction. **[2]**

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- (b)** Explain why the rate of an enzyme-catalysed reaction reaches a plateau as substrate concentration is increased, at a constant enzyme concentration.

[2]

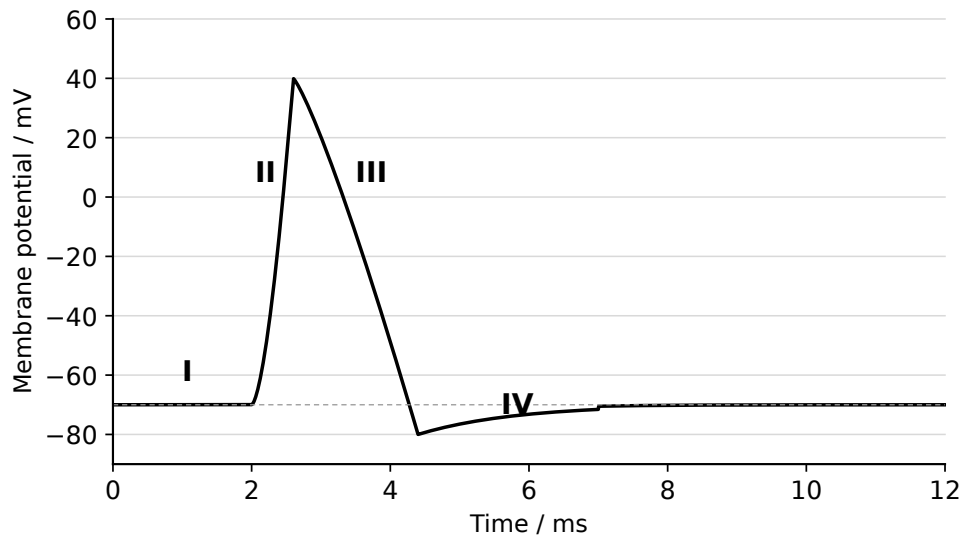
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- (c)** Distinguish between competitive and non-competitive inhibition of enzymes.

[2]

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3. The graph shows the changes in membrane potential recorded at one point on the axon of a motor neuron during an action potential. Four regions of the trace are labelled I to IV.



(a) Using the graph, state the resting potential of this neuron.

[1]

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(b) Explain the movements of ions that are responsible for the changes in membrane potential in regions II and III.

[3]

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(c) Outline the role of the sodium–potassium pump in a neuron.

[2]

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4. Water is carried from the roots to the leaves of a tree in xylem vessels.

- (a) Explain how water is moved to the top of a tall tree without the use of ATP by the xylem. [3]

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- (b) Outline **two** adaptations of xerophytes that reduce the rate of transpiration. [2]

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- (c) State **one** structural difference between a xylem vessel and a phloem sieve tube. [1]

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5. In humans, the heart beat is initiated within the heart itself but the rate can be adjusted.

- (a)** Explain how the sinoatrial node controls the sequence of contraction of the chambers of the heart.

[3]

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- (b)** Describe how the structure of an artery is adapted to its function.

[2]

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- (c)** State the effect of an increase in the concentration of carbon dioxide in the blood on the ventilation rate.

[1]

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6. In a species of flowering plant, flower colour is controlled by a gene with a dominant allele **R** (red) and a recessive allele **r** (white). Stem height is controlled by a second gene with a dominant allele **T** (tall) and a recessive allele **t** (dwarf). These two genes are located on different chromosomes.

- (a) A plant that is heterozygous for both genes is crossed with a plant that has white flowers and a dwarf stem. Deduce the expected ratio of phenotypes in the offspring, using a Punnett grid or other suitable diagram.

[3]

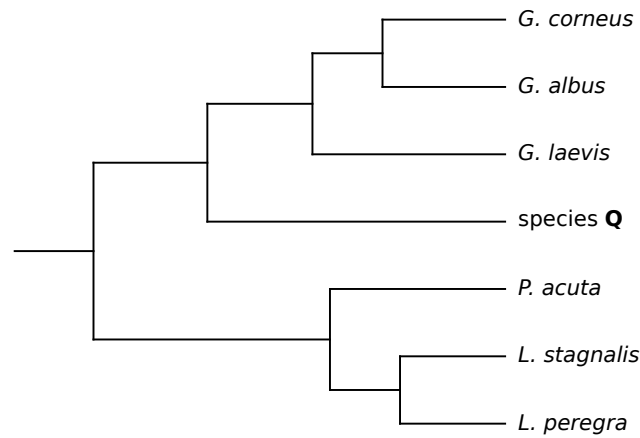
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- (b) Two further genes in this species, controlling leaf shape and petal shape, are located close together on the same chromosome. Explain why a cross of the same type would **not** be expected to give a 1:1:1:1 ratio of phenotypes for these two genes.

[2]

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7. The cladogram shows the relationships between seven species of freshwater snail, based on differences in the base sequence of a mitochondrial gene.



- (a) Identify, with a reason, whether the cladogram shows that species **Q** is more closely related to *G. laevis* or to *P. acuta*.

[2]

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- (b) Outline why a classification based on base sequences may differ from a classification based on external appearance.

[2]

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- (c) Outline **one** difficulty in applying the biological species concept to organisms that reproduce asexually.

[1]

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Section B

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

8. Proteins are polymers of amino acids and carry out a very wide range of functions in living organisms.

- (a) Using named examples, explain the relationships between the structure of proteins and their functions. [7]
- (b) Outline, with examples, the roles of water in living organisms. [5]
- (c) Distinguish between condensation and hydrolysis reactions, using named examples. [3]

9. The plasma membrane controls which substances enter and leave a cell.

- (a) Describe, with examples, the ways in which substances cross plasma membranes without the direct use of ATP. [4]
- (b) Explain the causes and the consequences of the movement of water into and out of animal cells and plant cells. [7]
- (c) Outline how the structure of a mitochondrion is adapted to its function in aerobic respiration. [4]

10. Populations change over time as a result of processes acting on the genetic variation that they contain.

- (a) Describe how meiosis produces genetically varied gametes. [5]
- (b) Outline how the gene pool of a small population can be changed by genetic drift and by gene flow. [3]
- (c) Explain the causes and the consequences of the evolution of antibiotic resistance in populations of bacteria. [7]

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End of examination.

Total: 80 marks