



Biology

Higher Level

Paper 1B — Mock Examination

Mock Exam 1

Calculator required

Time allowed: **55 minutes**

Maximum mark: **35 marks**

Candidate information

Candidate name:

Session number:

Date:

Topic emphasis: cell structure and microscopy, organelle function and bioenergetics, transport in plants, control of physiological processes, and natural selection. This is a data-based paper: it assesses experimental design, data analysis and the interpretation of unfamiliar biological information alongside syllabus content.

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.
- Answer **all** questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the biology data booklet is required for this paper.
- The maximum mark for this examination paper is **[35 marks]**.

The mark allocation is shown in square brackets at the end of each question. Where a calculation is required, show your working; marks may be awarded for a correct method even if the final answer is incorrect. Units and an appropriate number of significant figures should be given where relevant. Diagrams may be used in answers where they communicate the required biological detail clearly.

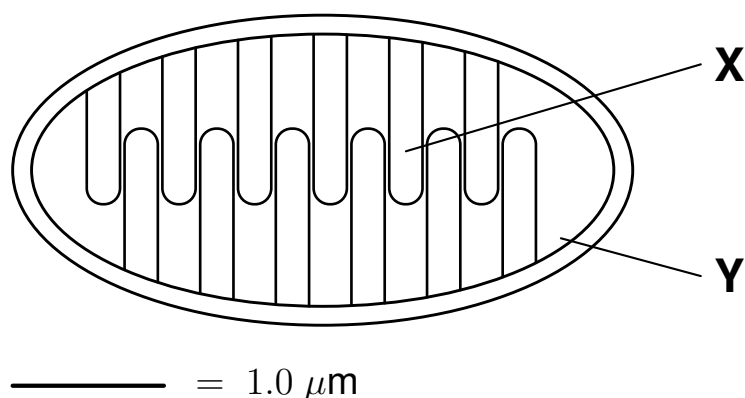
Mark allocation

Question	Marks
1 Cell structure and bioenergetics	[9 marks]
2 Physiological control and statistics	[9 marks]
3 Transport in plants	[9 marks]
4 Natural selection	[8 marks]
Total	[35 marks]

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

Question 1

The drawing was made from a transmission electron micrograph of a mitochondrion from a liver cell.



- (a) (i) The scale bar on the drawing is 20 mm long and represents 1.0 μm . Calculate the magnification of the drawing. [1]

Working:

Answer:

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- (ii) The maximum length of the mitochondrion in the drawing is 82 mm. Calculate its actual maximum length, in μm . [1]

Working:

Answer:

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Question 1 continued

- (b) State **one** advantage and **one** limitation of using an electron microscope rather than a light microscope to study mitochondria. [2]

Advantage:

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Limitation:

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- (c) Explain how the structure of the membrane labelled **X** is adapted for the production of ATP. [3]

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- (d) Suggest **one** reason why cardiac muscle cells contain many more mitochondria than epidermal cells of the skin. [2]

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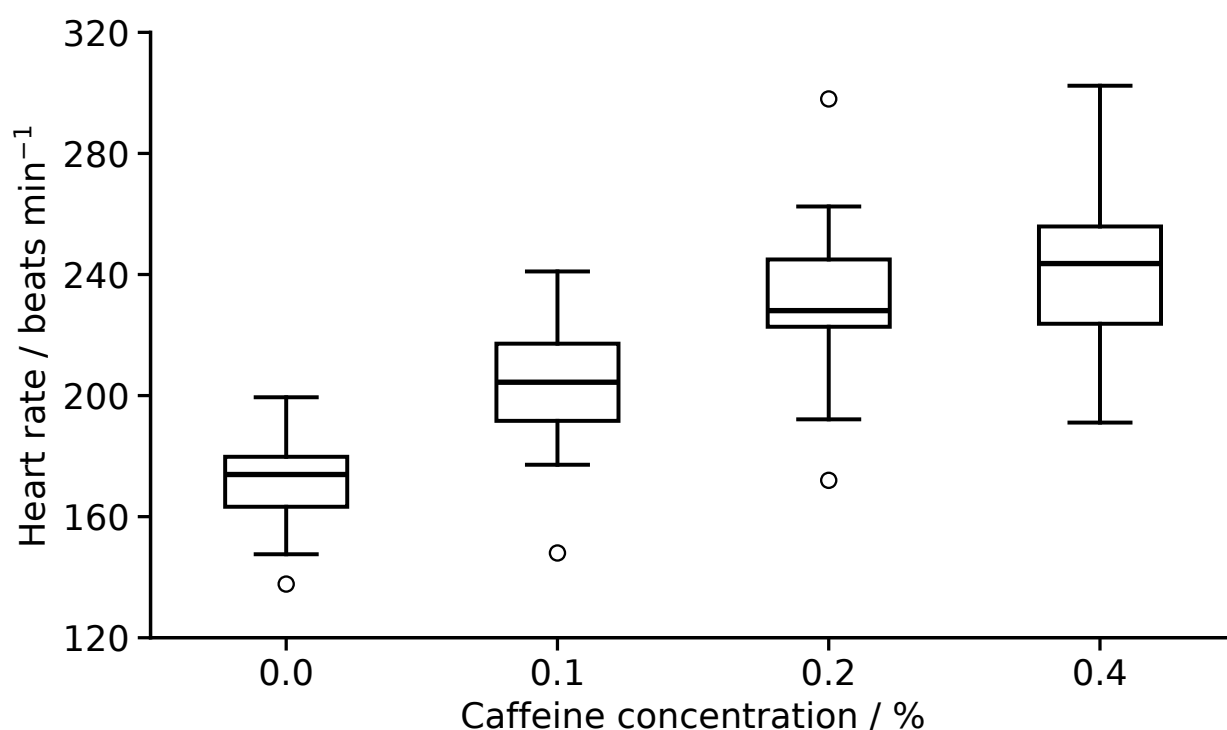
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Question 2

A student investigated the effect of caffeine on the heart rate of the water flea *Daphnia magna*. Each individual was placed in a drop of pond water on a cavity slide and viewed using a light microscope. The number of heart beats was counted over 20 seconds and converted to beats per minute. Thirty individuals were used at each caffeine concentration, and each individual was used only once.

The box-and-whisker plots show the heart rates recorded at each caffeine concentration.



(a) (i) State the dependent variable in this investigation. [1]

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Question 2 continued

- (ii) Identify what is represented by the small circles on the plot. [1]

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- (b) Compare and contrast the heart rates measured at caffeine concentrations of 0.2 % and 0.4 %. [2]

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- (c) Outline **one** strength and **one** limitation of the method used in this investigation. [2]

Strength:
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Limitation:
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Question 2 continued

- (d) The student concluded that caffeine increases the heart rate of *Daphnia*. Explain how a *t*-test could be used to support this conclusion. [3]

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Question 3

Leafy shoots of sunflower (*Helianthus annuus*) were used to investigate the effect of wind speed on the rate of water uptake. A fan was used to generate air movement across the leaves and the rate of water uptake was recorded at five wind speeds. All shoots were taken from plants of the same age and grown under identical conditions.

The table shows the mean rate of water uptake, the standard deviation (SD) and the number of measurements taken at each wind speed.

Wind speed / m s^{-1}	Mean rate of water uptake / $\text{mm}^3 \text{min}^{-1}$	SD / $\text{mm}^3 \text{min}^{-1}$	Number of measurements
0.0	3.1	0.4	12
1.0	5.4	0.6	12
2.0	7.9	0.9	11
4.0	9.6	1.5	10
6.0	10.1	—	1

- (a) State the name of the apparatus used to measure the rate of water uptake by a leafy shoot. [1]

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- (b) Suggest **one** reason for not calculating a standard deviation at a wind speed of 6.0 m s^{-1} . [1]

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Question 3 continued

- (c) Calculate the percentage increase in the mean rate of water uptake between wind speeds of 0.0 m s^{-1} and 4.0 m s^{-1} . [1]

Working:

Answer:

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- (d) Explain the effect of increasing wind speed on the rate of transpiration. [3]

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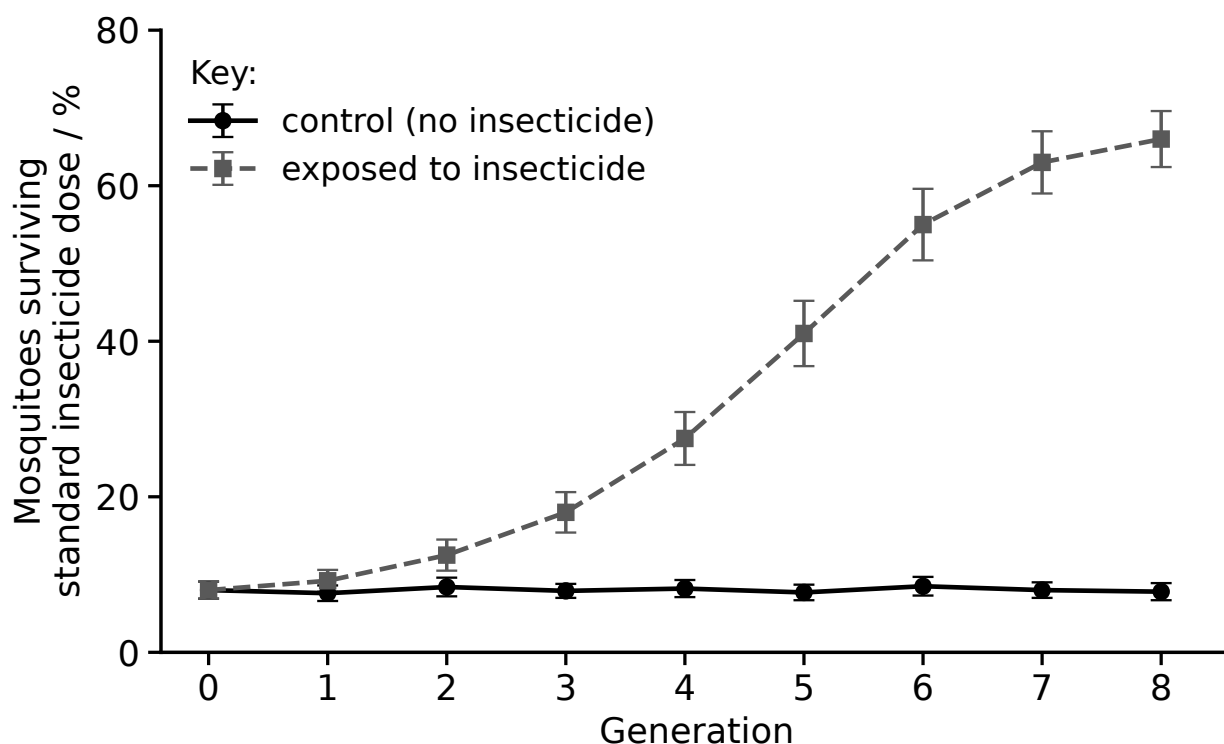
- (e) Outline how water is transported from the roots to the leaves of a plant. [3]

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Question 4

Insecticides are used to control populations of the mosquito *Anopheles gambiae*, which transmits the parasite that causes malaria. In a laboratory experiment, mosquitoes from a single starting population were divided between two sets of cages. In each generation, mosquitoes in the exposed cages were treated with a standard dose of insecticide and the survivors were used to produce the next generation. Mosquitoes in the control cages were not treated.

In every generation, a sample from each population was tested with the standard dose and the percentage surviving was recorded. The graph shows the mean and standard deviation (SD) for three replicate populations.



- (a) List **two** variables, other than the insecticide treatment, that must be kept constant in this experiment. [2]

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Question 4 continued

- (b) Describe the trend shown by the population exposed to the insecticide. [2]

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- (c) Explain how natural selection accounts for the change in the exposed population. [4]

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End of examination. Total: **35 marks**