Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 1B

28 October 2025

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

Candidate session number

2 hours [Paper 1A and Paper 1B]

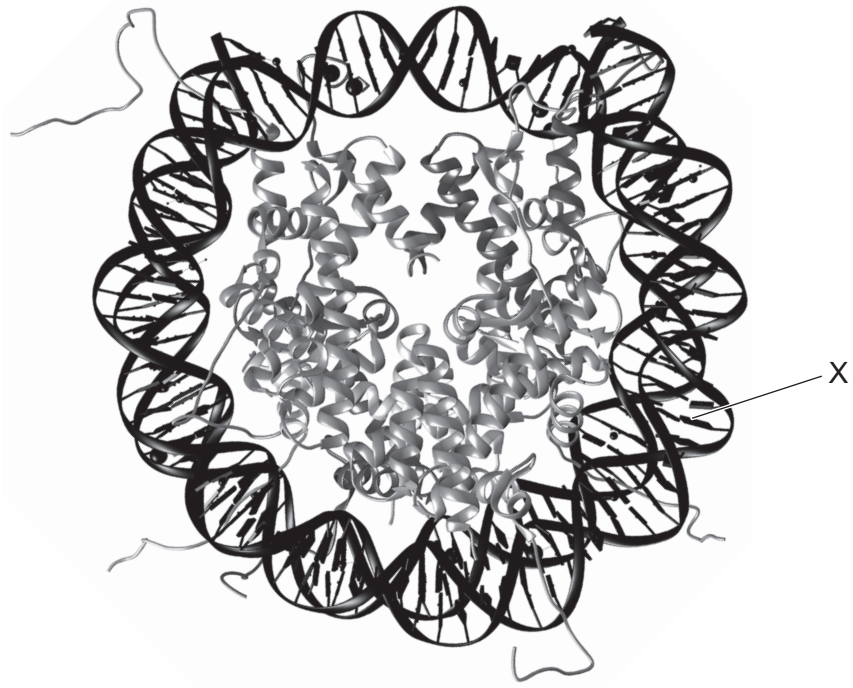
Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for paper 1B is **[35 marks]**.
- The maximum mark for paper 1A and paper 1B is **[75 marks]**.

8825–6008

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

1. The image of a nucleosome was obtained using molecular visualization software.



(a) (i) Adenine forms hydrogen bonds with the nitrogenous base X. Identify X. [1]

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(ii) Suggest **one** benefit and **one** disadvantage of using molecular visualization. [2]

Benefit: . . . . . .

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Disadvantage: . . . . . .

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(This question continues on the following page)

(Question 1 continued)

(b) Describe the structure of the nucleosome. [3]

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(c) Explain how methylation of nucleosomes affects DNA transcription. [2]

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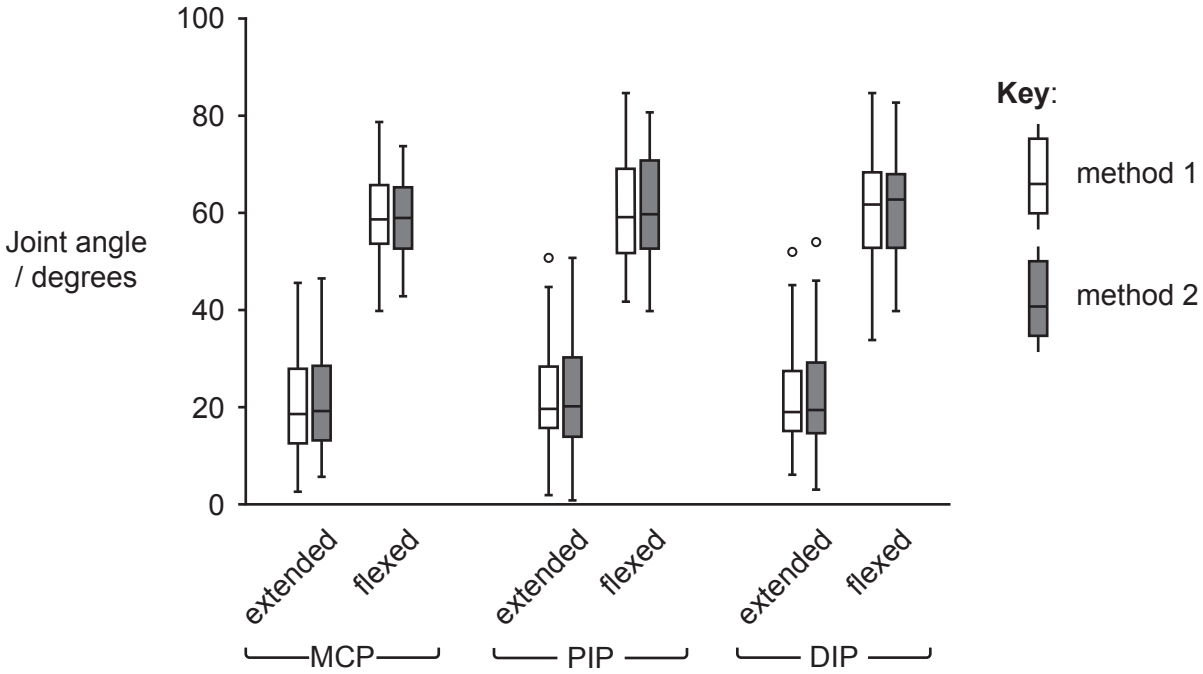
2. A student used two different methods to measure the left ring finger joint angles in 120 healthy people. The metacarpophalangeal (MCP), proximal interphalangeal (PIP) and distal interphalangeal (DIP) joint angles were measured while the finger was extended (straight) or flexed (bent).

The box-and-whisker plots show the angle measurements at the different joints obtained for both methods.



(This question continues on the following page)

(Question 2 continued)

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

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(ii) Identify what is indicated by the circles in the plot. [1]

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(b) Deduce whether method 2 is a good substitute for method 1. [1]

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(c) Evaluate the experiment used to measure the joint angles of the ring finger. [2]

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(d) Explain the reason that the angle measured by both methods is smaller in the extended than in the flexed position. [3]

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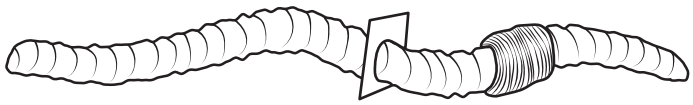
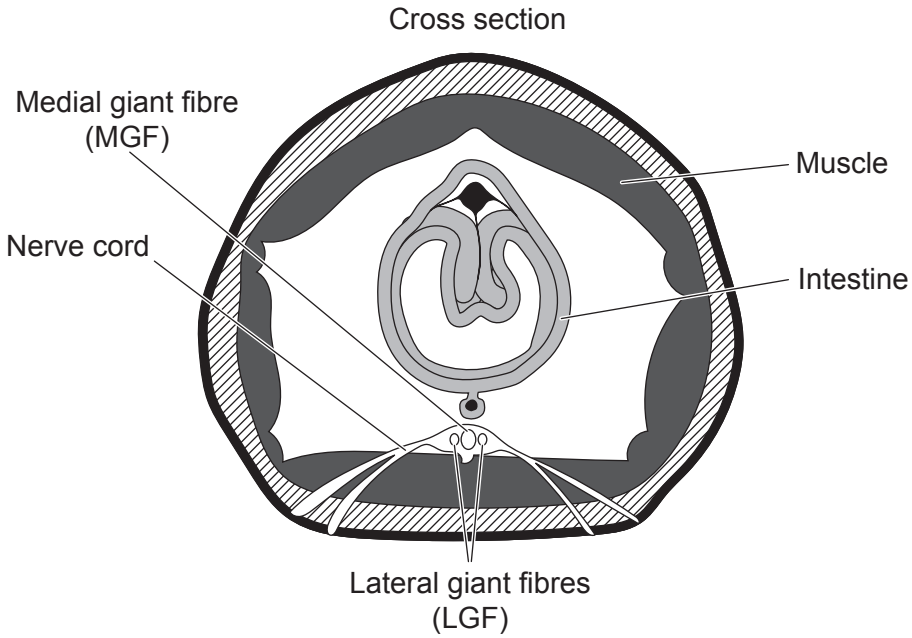
3. Earthworms (*Lumbricus terrestris*) have a nerve cord on the ventral (underside) side of their body. It contains three nerve fibres (axons), each with a very large diameter, which extend along the whole length of the nerve cord. There is one medial giant fibre (MGF) and two lateral giant fibres (LGFs). The diameter of the MGF is 1.4 times larger than the LGF.

Scientists developed a non-invasive method to record giant nerve fibre activity. The response from the MGF was measured by the electrical activity produced when touching the front segments of the earthworm while the LGF was measured when touching the back segments.





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(Question 3 continued)

The table shows the mean conduction rates, standard deviation (SD) and number of individual measurements of MGF and LGF action potentials in each earthworm. At the end of the table, the mean and standard error (SE) for 9 of the earthworms are shown.

	MGF			LGF		
Earthworm	**Mean conduction rate / $m s^{-1}$**	**SD / $m s^{-1}$**	**Number of measurements**	**Mean conduction rate / $m s^{-1}$**	**SD / $m s^{-1}$**	**Number of measurements**
1	38.1	5.1	24	13.7	2.0	21
2	31.4	6.8	17	13.4	1.8	13
3	29.2	4.7	13	11.4	2.2	19
4	29.7	7.5	17	11.7	2.8	12
5	29.7	4.1	6	11.4	1.6	16
6	36.1	5.8	23	13.6	2.1	16
7	30.1	4.9	17	12.8	2.7	19
8	33.5	4.4	16	11.9	1.5	18
9	32.2	5.3	23	13.7	2.1	21
10	33.3	–	1	15.5	2.0	3
Mean / $m s^{-1}$	**32.2**			**12.6**		
SE / $m s^{-1}$		**1.0**			**0.3**	

(This question continues on the following page)

(Question 3 continued)

(a) State the apparatus used to show the resting and action potentials. [1]

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(b) (i) Distinguish between SD and SE. [2]

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(ii) Suggest **one** reason for not calculating the SD for earthworm 10. [1]

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(c) (i) Calculate how many times faster the mean MGF is compared to the mean LGF. [1]

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(ii) Suggest **one** possible reason that the conduction rate in the MGF is much faster than in the LGF. [1]

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(Question 3 continued)

(d) Explain saltatory conduction. [3]

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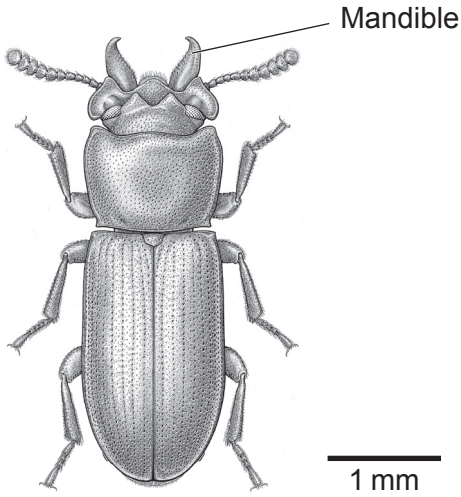
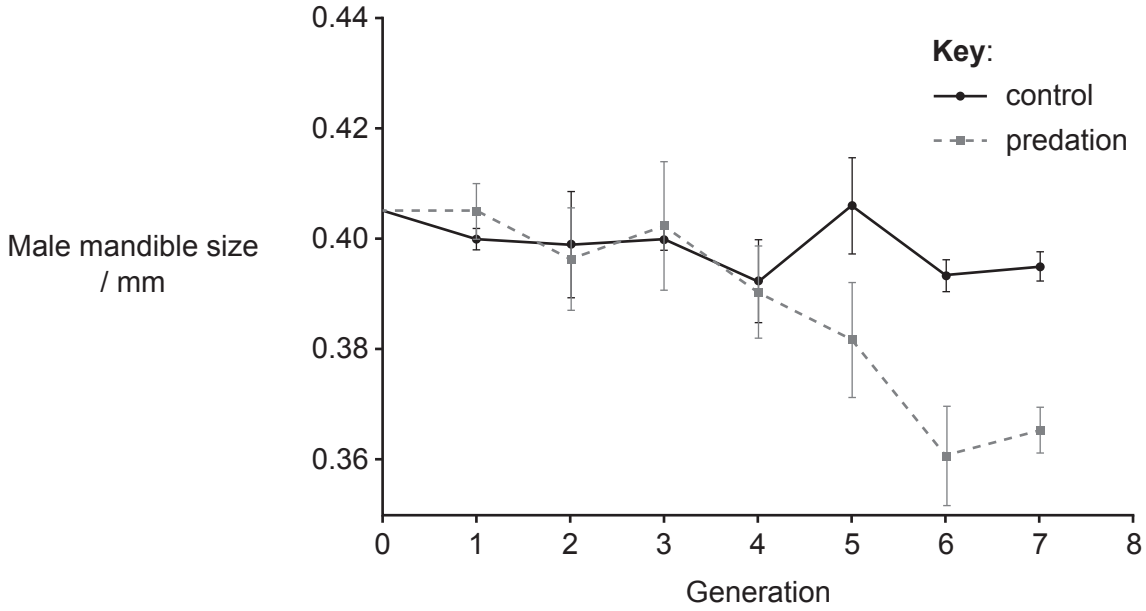
4. Mandible (mouthpart) size is variable in the male broadhorned flour beetle (*Gnatocerus cornutus*).



In a laboratory experiment, scientists investigated how natural selection by predation on flour beetles by the larger assassin bug (*Amphibolus venator*) affected male mandible size. The graph shows the mean and standard deviation (SD) male mandible size over seven generations in three replicate experiments. Control populations were not subjected to predation.



(a) (i) State the reason that a ruler is not a suitable piece of equipment for precisely measuring the length of the mandible. [1]

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(Question 4 continued)

(ii) Suggest how the mandible size of the flour beetles could have been measured in this experiment. [1]

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(b) List **two** variables that need to be kept constant in this experiment. [2]

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(c) Describe the trend for male mandible size with predation. [2]

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(d) Explain how natural selection by predation affects male mandible size in flour beetles. [4]

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References:

1. Harp, J.M., Hanson, B.L., Timm, D.E. and Bunick, G.J., 2000. Asymmetries in the nucleosome core particle at 2.5 Å resolution. *Acta Crystallographica Section D Biological Crystallography* 56(12), pp. 1513–1534. https://doi.org/10.1107/s0907444900011847. Source adapted.

2. Macionis, V. Reliability of the standard goniometry and diagrammatic recording of finger joint angles: a comparative study with healthy subjects and non-professional raters. *BMC Musculoskelet Disord* 14, 17 (2013). https://doi.org/10.1186/1471-2474-14-17.

3. Used with permission of the *Journal of Experimental Biology*, from Giant Nerve Fibre Activity In Intact, Freely Moving Earthworms, by Drewes, C.D, Landa, K.B. and McFall, J.L., *J. Exp. Biol.* 73, pp. 317–227, 1978. Available at: https://journals.biologists.com/jeb/article-abstract/72/1/217/22476/Giant-Nerve-Fibre-Activity-in-Intact-Freely-Moving?redirectedFrom=fulltext. Permission conveyed through Copyright Clearance Center, Inc. Source adapted.

4. Diagram: Bousquet Y, et al., 2018. Figure 36; *Gnatocerus* (*Gnatocerus*) *cornutus* (Fabricius, 1798). [image online] Available at: https://commons.wikimedia.org/wiki/File:Gnatocerus_(Gnatocerus)_cornutus_(10.3897-zookeys.728.20602)_Figure_36.jpg. Licensed under the Creative Commons Attribution 4.0 International license: https://creativecommons.org/licenses/by/4.0/deed.en. [Accessed 30 September 2024]. Source adapted.

Graph: Okada, K., Katsuki, M., Sharma, M.D., et al., 2021. Natural selection increases female fitness by reversing the exaggeration of a male sexually selected trait. *Nat Commun* 12, 3420. https://doi.org/10.1038/s41467-021-23804-7. Licensed under a Creative Commons Attribution 4.0 International License: https://creativecommons.org/licenses/by/4.0/. Source adapted.