Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 1B

12 May 2025

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

Candidate session number

2 hours [Paper 1A and Paper 1B]

Instructions to candidates

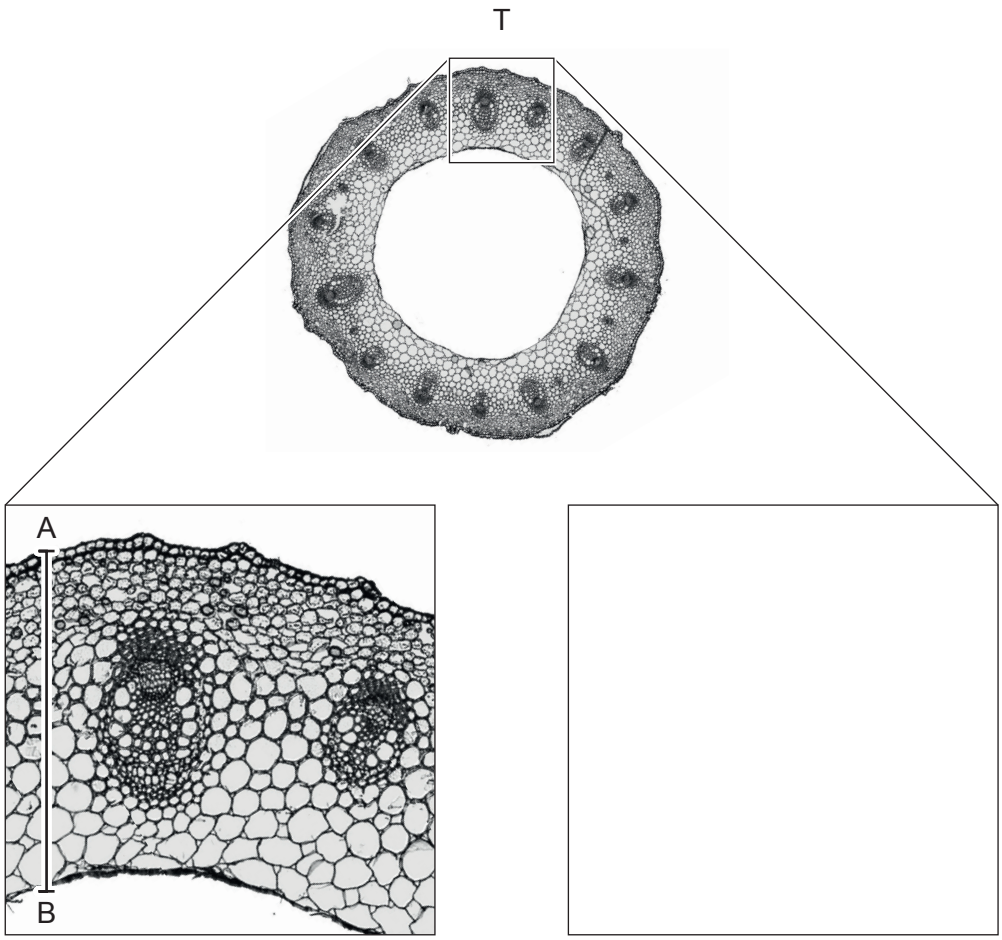
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for paper 1B is **[35 marks]**.
- The maximum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

2225 – 6008

9 pages

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

1. The micrograph shows a buttercup (*Ranunculus bulbosus*) stem in transverse section. Region T has been highlighted to show more detail.



(a) In the right-hand box, draw a **labelled** plan diagram of region T to show the distribution of tissues. [3]

(b) (i) Calculate the actual thickness of the stem, measured by the line AB that has been magnified 100×. [1]

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(This question continues on the following page)

(Question 1 continued)

(ii) Outline how the actual thickness of the stem could be calculated using a microscope with an eyepiece graticule. [1]

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(c) State **one** way in which plants can protect themselves from herbivores. [1]

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(d) Explain **two** adaptations of leaves that allow plants to live in hot deserts. [2]

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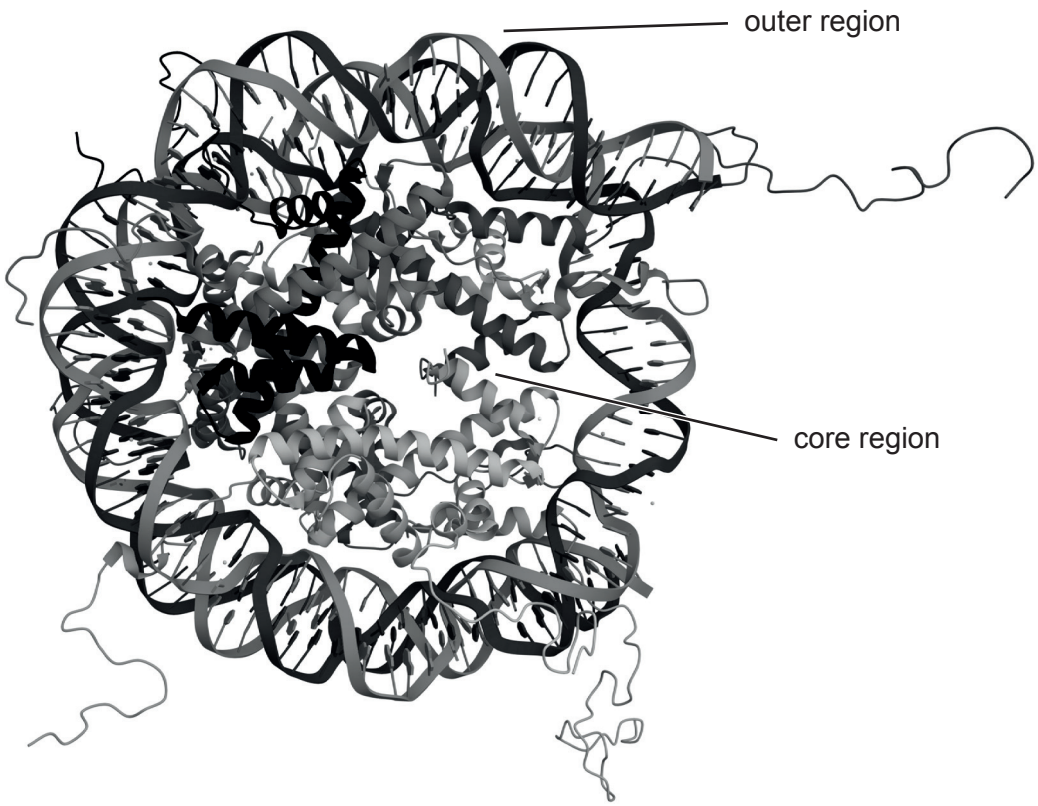
2. Molecular visualization software was used to produce the representation of a human nucleosome.



(a) Using the image,

(i) identify, giving a reason, the molecule found in the outer region. [1]

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(ii) describe the structure of the core region. [2]

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(Question 2 continued)

(b) Suggest a reason that nucleosomes are absent in bacterial DNA. [1]

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(c) Explain how DNA can be used in cladistics. [4]

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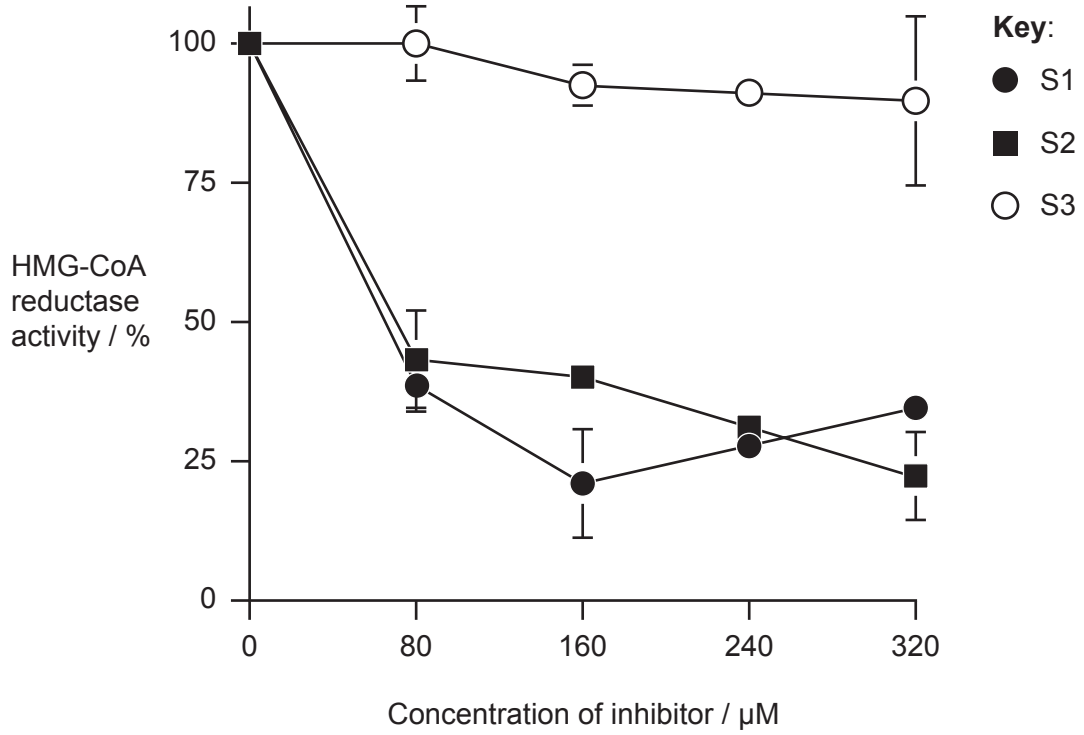
3. The inhibitory effect of three different statins (S1, S2 and S3) on the activity of HMG-CoA reductase, an enzyme involved in cholesterol metabolism in the liver, was investigated.



(a) (i) Identify an independent variable in this investigation. [1]

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(ii) State **one** variable that needs to be controlled. [1]

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(Question 3 continued)

(b) Compare and contrast the effect of increasing concentrations of S1 and S2 on the mean activity of HMG-CoA reductase. [3]

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(c) Outline how the rate of reaction of HMG-CoA reductase can be calculated. [1]

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(d) Statins limit the synthesis of cholesterol by acting as competitive inhibitors. Distinguish between competitive and non-competitive inhibition. [1]

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(e) Describe the role of enzymes in **one named** process that prevents infections in the human body. [2]

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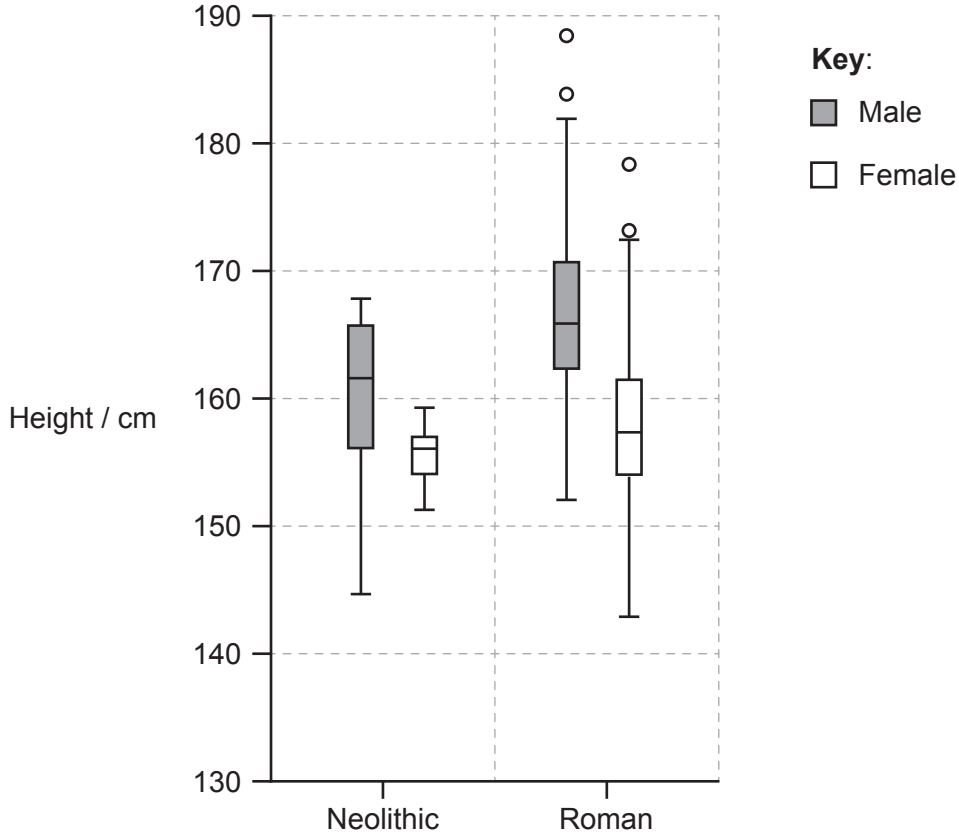
4. Male and female human skeletons obtained from different archaeological sites in Greece were studied in order to find trends in human height evolution in Europe. The box-and-whisker plots show heights of skeletons dating from two historical periods: Neolithic (6500–3000 BC) and Roman (146–324 AD).



(a) Using the graph,

(i) estimate the median height of females in the Roman period. [1]

. . . . . cm

(ii) estimate the maximum height of males in the Neolithic period. [1]

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(Question 4 continued)

(iii) State the reason that some of the data points were plotted outside the whiskers. [1]

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(b) Using the data, discuss the hypothesis that variation in human height is due to polygenic inheritance. [2]

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(c) Phenotypic variation allows natural selection within populations. Compare and contrast directional and disruptive selection. [2]

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(d) Discuss the use of the Hardy–Weinberg equation in population genetics studies. [3]

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References:

1. Reschke, E., 2012. *Stem Cross Section: Buttercup (Ranunculus)*. [image online] Available at: https://www.gettyimages.com.mx/detail/foto/buttercup-herbaceous-dicot-8x-shows-vascular-imagen-libre-de-derechos/139803635 [Accessed 18 June 2024]. Source adapted.

2. RCSB Protein Data Bank, n.d. *X-Ray Structure of the Nucleosome Core Particle, NCP147, at 1.9 A Resolution*. [image online] Available at: https://www.rcsb.org/3d-sequence/1KX5?assemblyI [Accessed 18 June 2024]. Source adapted.

3. Rao, S., Porter, D., Chen, X., Herliczek, T., Lowe, M. and Keyomarsi, K., © 1999, The National Academy of Sciences. Lovastatin-mediated G1 arrest is through inhibition of the proteasome, independent of hydroxymethyl glutaryl-CoA reductase. *Proc Natl Acad Sci USA* 96, pp. 7797–7802. https://doi.org/10.1073/pnas.96.14.7797. Source adapted.

4. Koukli, M., Siegmund, F. and Papageorgopoulou, C., 2023. Stature estimation in Ancient Greece: population-specific equations and secular trends from 9000 BC to 900 AD. *Archaeol Anthropol Sci* 15(53). https://doi.org/10.1007/s12520-023-01744-1. Source adapted.

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