Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Standard level
Paper 1B

12 May 2025

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

Candidate session number

1 hour 30 minutes [Paper 1A and Paper 1B]

Instructions to candidates

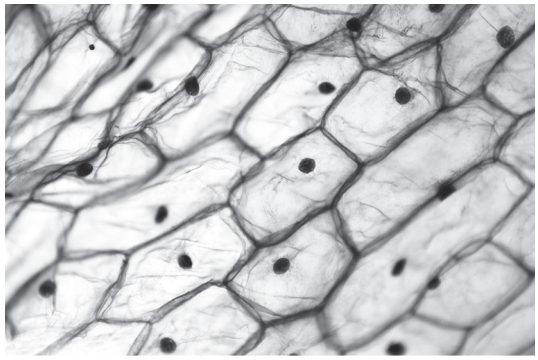
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for paper 1B is **[25 marks]**.
- The maximum mark for paper 1A and paper 1B is **[55 marks]**.

2225 – 6023

9 pages

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

1. The image shows epidermis tissue from a bulb of the onion plant (*Allium cepa*) viewed using a light microscope.



50 μm

(a) Calculate the magnification of the image. [1]

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(b) State the item of equipment that a student could use to accurately measure the length of an onion cell viewed using a light microscope. [1]

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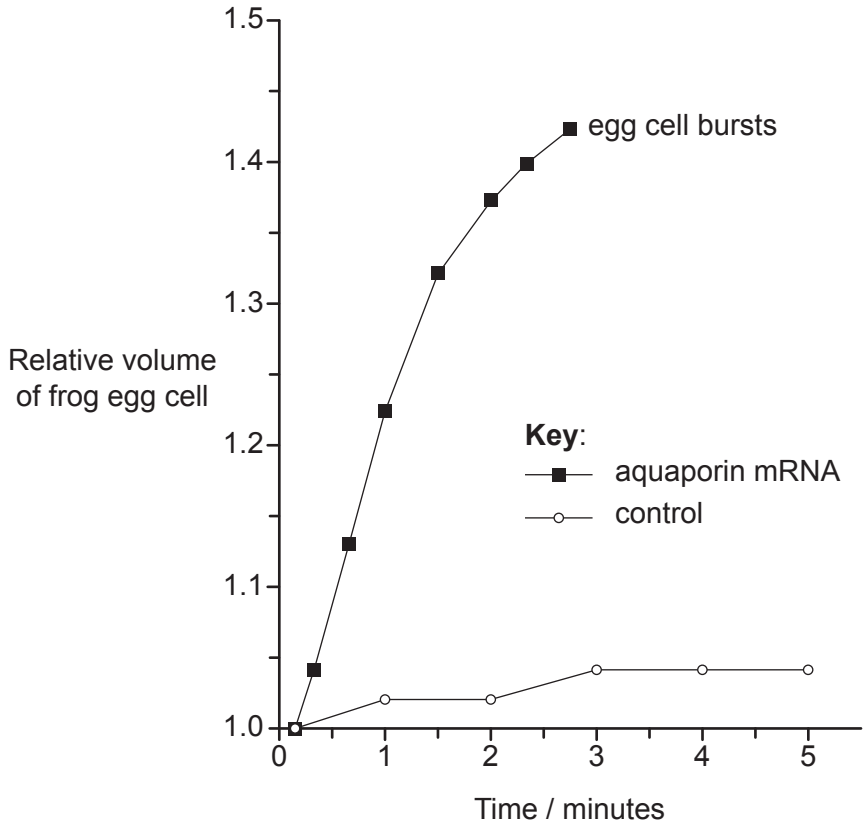
(Question 1 continued)

(c) Draw a labelled diagram of a nucleus from a eukaryotic cell, such as an onion epidermis cell, as seen using an **electron** microscope. [3]

2. In the early 1990s, investigations involving egg cells from the African clawed frog (*Xenopus laevis*) led to the discovery of membrane channel proteins called aquaporins.

In one investigation, scientists injected 10 frog egg cells with a solution containing mRNA encoding for an aquaporin, and another 10 frog egg cells with distilled water (control cells). All the frog egg cells were then incubated in a hypotonic solution. The volume of the frog egg cells was then measured during a period of five minutes.

The graph shows the mean results of the investigation.



(a) State the direction of net movement of water across the plasma membrane of all the frog egg cells between 0 and 3 minutes. [1]

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(Question 2 continued)

(b) (i) Distinguish between the results shown for the frog egg cells with aquaporin mRNA and the control egg cells. [2]

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(ii) Explain the role of aquaporins in the movement of water across cell membranes. [2]

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(c) Outline the reason that the results are displayed as mean relative volumes rather than mean volumes. [1]

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(d) Comment on the reliability of the results of this investigation. [1]

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3. The image shows a castor bean tick (*Ixodes ricinus*) which is commonly found in woodlands or forest areas. This tick can carry bacteria that cause Lyme disease in humans.

(a) Explain how the capture–mark–release–recapture method could be used to estimate the size of a tick population. [3]

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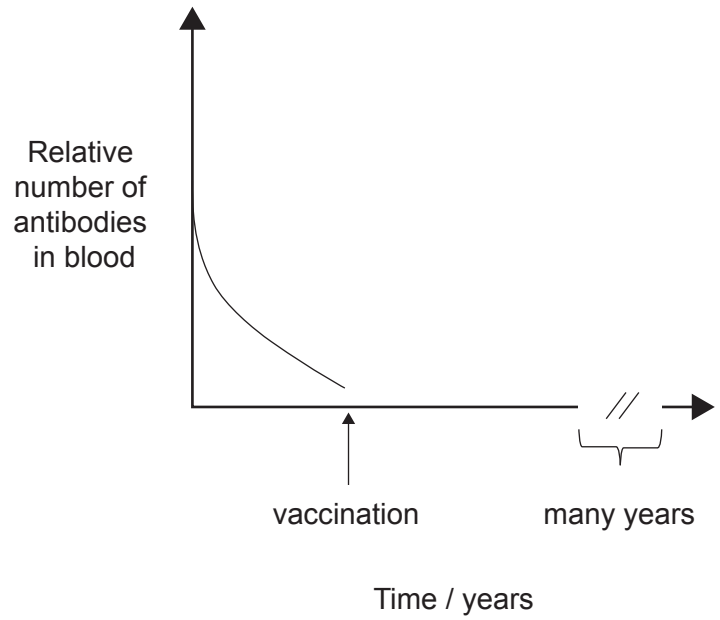
(Question 3 continued)

A vaccine has been developed to protect people against the symptoms of Lyme disease.

The graph shows the relative number of antibodies specific to these bacteria in the blood of a person **before** vaccination.



(b) (i) Suggest what can be concluded from the graph about the person before they were vaccinated. [1]

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(ii) Sketch a line on the graph to show how the number of antibodies would change over time after vaccination. [1]

(c) Some symptoms of Lyme disease are caused by damage to the central nervous system (CNS). State **both** parts of the CNS. [1]

1. . . . . .

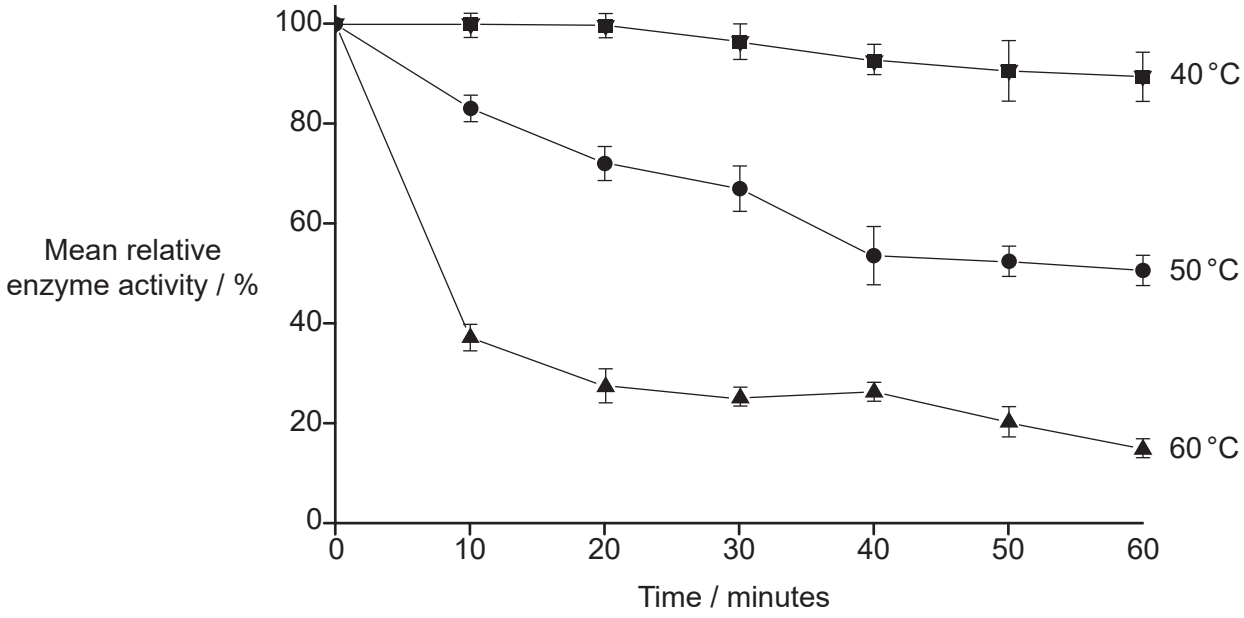
2. . . . . .

4. A scientist investigated the effect of storage temperature on the activity of an enzyme.

The scientist incubated three lipase solutions for one hour at three different storage temperatures (40 °C, 50 °C or 60 °C).

At every 10-minute interval, a sample of lipase solution was taken and immediately used to catalyse the digestion of a small volume of oil. The values were then compared to the results obtained at the optimum temperature for lipase (37 °C). Relative enzyme activity values were determined.

The graph shows the mean results of the investigation.



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

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(b) Identify **one** factor that needs to be controlled in this investigation. [1]

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(Question 4 continued)

(c) Explain the relationship shown between storage temperature and relative enzyme activity. [2]

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(d) Describe how the reliability of the results obtained in this investigation is indicated on the graph. [1]

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(e) When oils are digested, fatty acids are produced. These reduce the pH of the reaction mixture. Explain how the rate of reaction could be measured in this investigation. [2]

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References:

1. PeterHermesFurian, 2017. *Onion epidermis with large cells under light microscope*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/onion-epidermis-with-large-cells-under-light-royalty-free-image/655178448 [Accessed 29 April 2024]. Source adapted.

2. Reproduced from Gregory M. Preston et al., Appearance of Water Channels in Xenopus Oocytes Expressing Red Cell CHIP28 Protein, DOI: 10.1126/science.256.5055.385. 1992, AAAS.

3. Lezh, 2008. *Ixodid tick*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/ixodid-tick-royalty-free-image/157332347 [Accessed 30 April 2024]. Source adapted.

4. Zheng, C., 2021. Study on enzymatic activity and lipase catalysis by lipase high-yield strain. Conf. Ser.: Earth Environ. Sci. 632 032016. https://doi.org/10.1088/1755-1315/632/3/032016. Source adapted.

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