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Biology
Higher level
Paper 1B

11 May 2026

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

Session number

2 hours [Paper 1A and Paper 1B]

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Instructions to students

- 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]**.



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

1. (a) (i) Distinguish between the structure of a plant cell and a fungal cell. [2]

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- (ii) Distinguish between the structure of a plant chromosome and a bacterial chromosome. [2]

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- (b) A student prepared a temporary mount of cells from the tip of an onion (*Allium cepa*) root in order to view cells in mitosis using a light microscope.

- (i) Outline the reason that the onion cells were stained during this preparation. [1]

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- (ii) Describe how the student would have calculated a mitotic index of the onion tissue and ensured that this value was reliable. [2]

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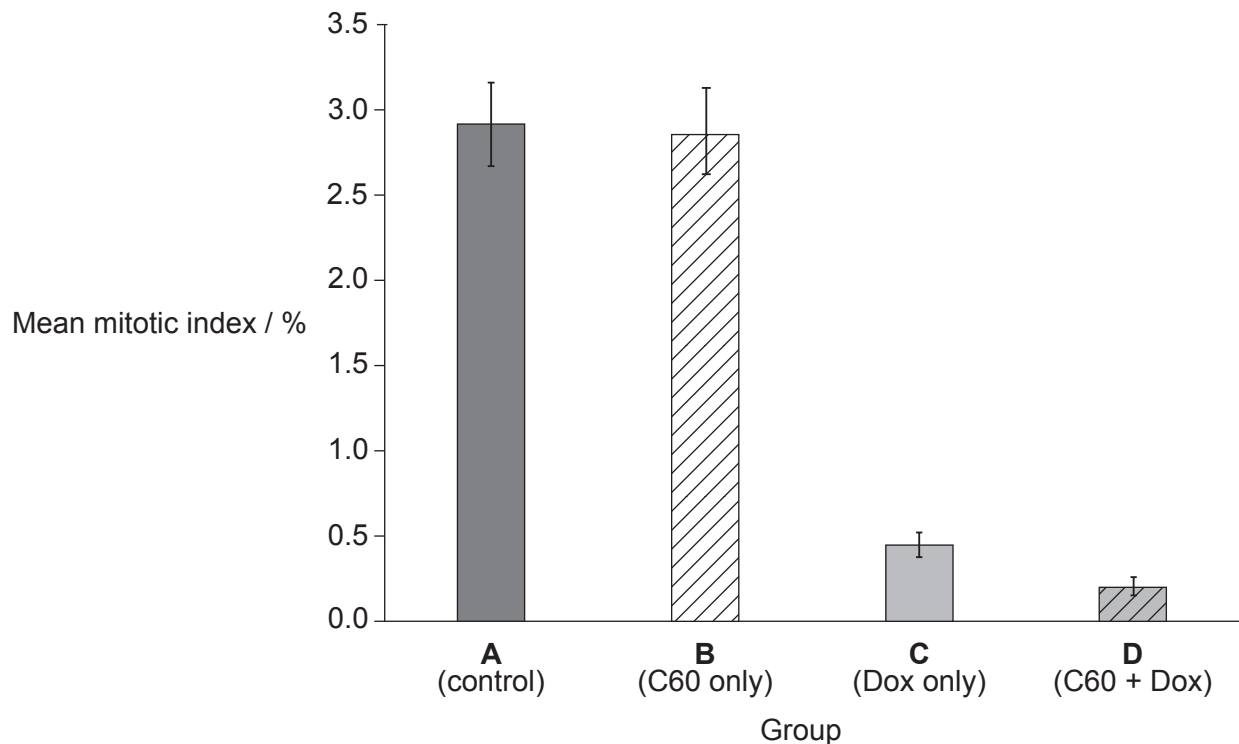


(Question 1 continued)

Scientists investigated the effect of two chemicals, C60 and Dox, on the mitotic index of tumour tissue. They randomly divided the tumour tissue into four groups and treated each group with a solution as follows:

- Group **A** did not receive either chemical (control)
- Group **B** received C60 only
- Group **C** received Dox only
- Group **D** received both C60 and Dox

After a fixed time, samples of tumour tissue were taken from each group. These were viewed using a light microscope, and the mean mitotic index for each group was then determined. The graph shows their results.



- (c) Deduce the conclusions that can be drawn about the effectiveness of C60, Dox and a combination of these chemicals in reducing tumour growth.

[3]

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2. Beetroot (*Beta vulgaris*) cells contain a red pigment, which leaks out when the plasma membrane becomes damaged.

Students investigated the effect of temperature on membrane permeability in beetroot cells.

During this procedure, the students:

Step 1. cut equal-sized discs of beetroot

Step 2. washed the beetroot discs in running water

Step 3. added five beetroot discs to 10 cm³ of buffer solution in a test tube

Step 4. incubated the test tube in a water bath at 30 °C for 30 minutes

Step 5. removed the beetroot discs from the test tube and stirred the solution

Step 6. measured the absorbance of the solution using a colorimeter

Step 7. repeated this method three times

Step 8. repeated this method at water bath temperatures of 40 °C, 50 °C, 60 °C, 70 °C and 80 °C.

- (a) Outline the reason for using equal-sized discs of beetroot in **step 1**. [2]

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- (b) Describe how the students could have monitored the water bath temperature to ensure that it remained constant in **step 4**. [1]

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- (c) The students carried out repeats at each temperature. Outline the reason for this. [1]

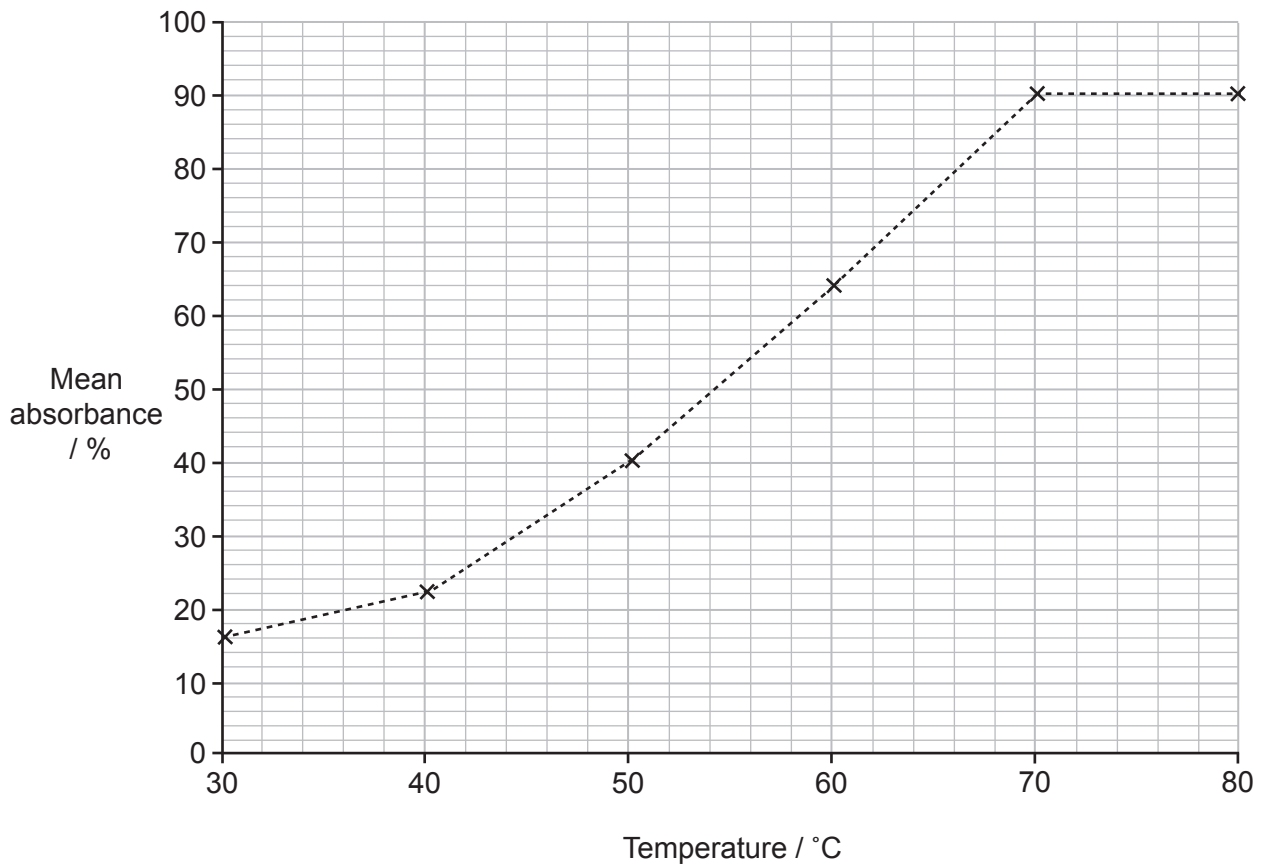
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(Question 2 continued)

(d) The graph shows the students' results.



Using your knowledge of membrane structure, explain the relationship between temperature and mean absorbance.

[3]

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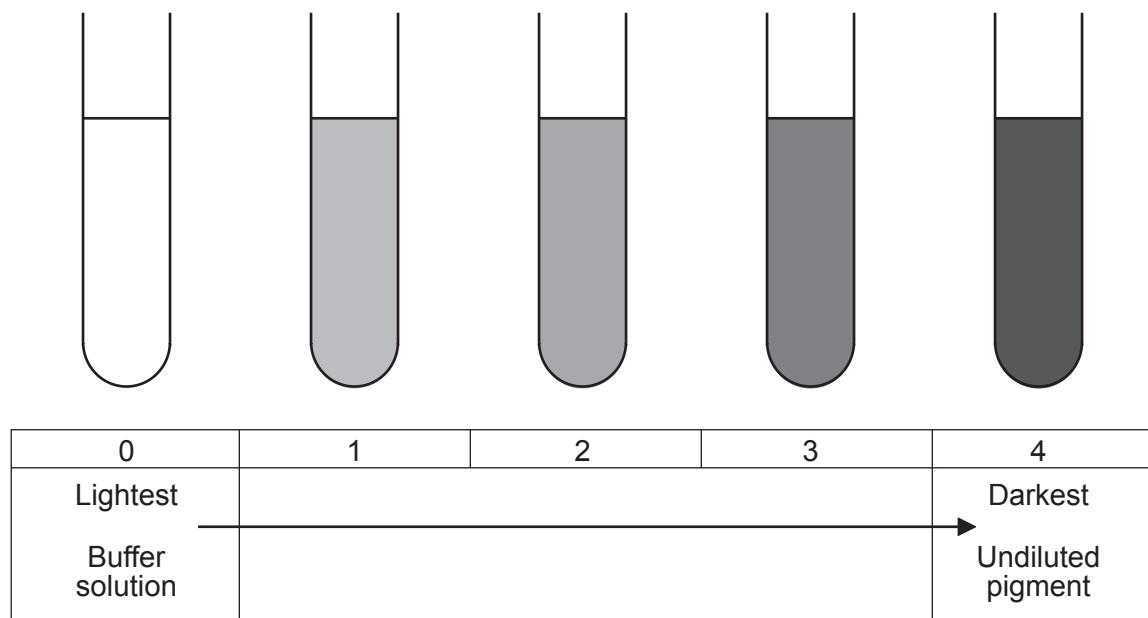
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(Question 2 continued)

Another group of students determined the colour intensity of their solutions in a different way. They produced a colour scale by diluting the red pigment with buffer solution and assigned values (from 0 to 4) according to how dark each solution was.

The students then viewed the colour intensities of their solutions and compared them to the colour scale, as shown.



- (e) Suggest **two** advantages of using a colorimeter to measure colour intensity rather than using a colour scale.

[2]

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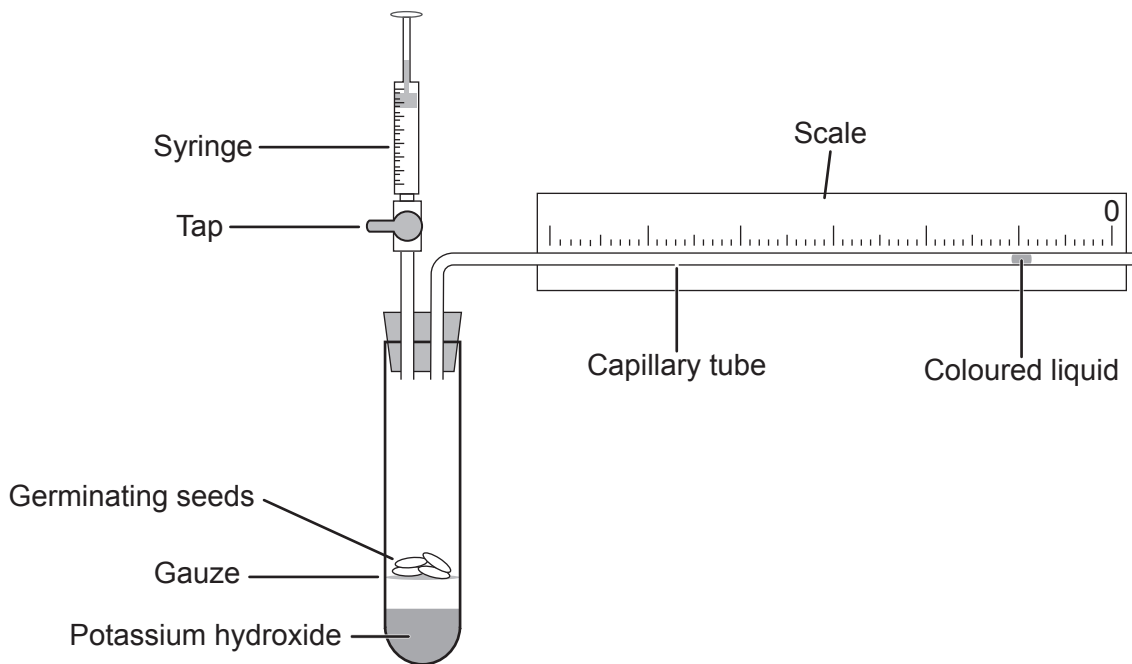
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3. Students investigated the effect of temperature on the rate of respiration of germinating seeds using a respirometer, as shown.



- (a) The potassium hydroxide in the tube absorbs any carbon dioxide produced by the germinating seeds.

Explain the reason that the coloured liquid moves to the left when the germinating seeds respire.

[2]

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- (b) The syringe contains air. After each test run, the students opened the tap and pushed down on the syringe.

Outline how this allowed repeat measurements to be taken.

[1]

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(Question 3 continued)

- (c) The coloured liquid in the capillary tube moved 26 mm in 24 hours.

The radius of the capillary tube was 0.5 mm.

The volume of the capillary tubing can be calculated by $\pi r^2 l$, where r is the radius, π is 3.14 and l is the length.

Calculate the rate of oxygen uptake by the seeds in $\text{mm}^3 \text{h}^{-1}$ to **two** decimal places. [1]

..... $\text{mm}^3 \text{h}^{-1}$

- (d) The students also set up a control experiment for comparison. In this, they replaced the germinating seeds with the same mass of plastic beads.

Outline the purpose of this control experiment. [1]

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- (e) Explain how ATP is produced by chemiosmosis during aerobic respiration. [4]

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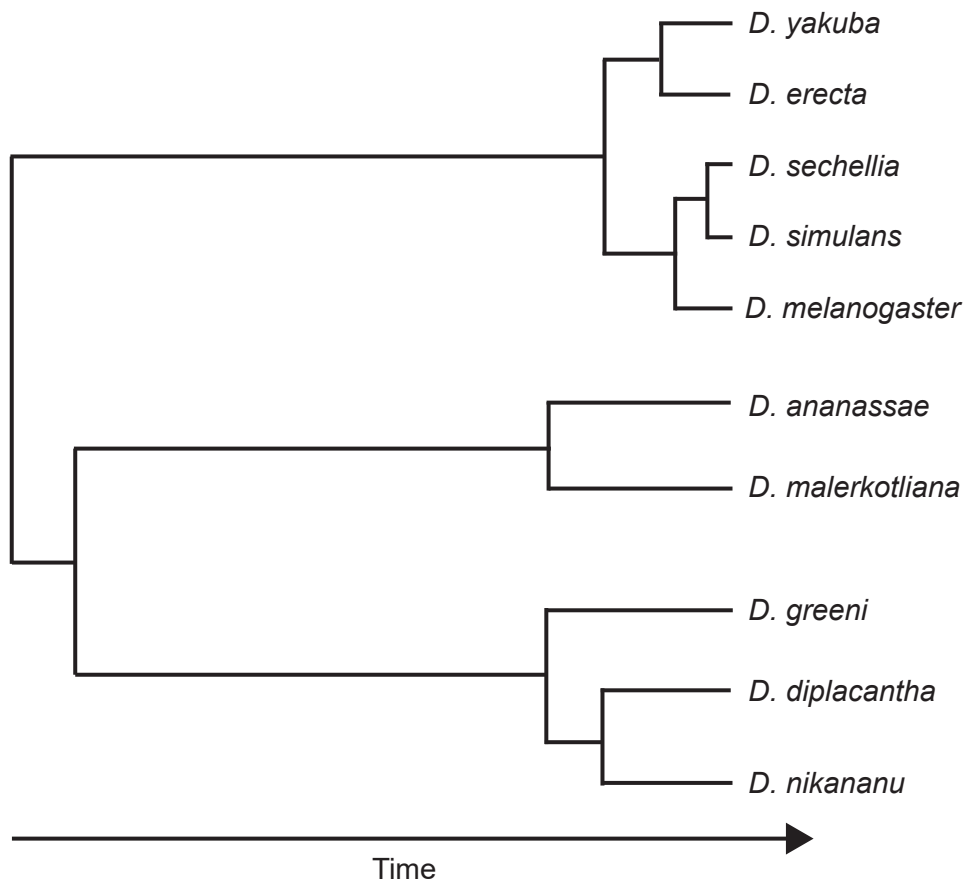


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4. (a) The cladogram shows the evolutionary relationships between ten species of fly that belong to the genus *Drosophila*.



- (i) Identify, with a reason, which **two** species of fly are the most closely related. [2]

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- (ii) Comparing the base sequence of a gene is more accurate than comparing the amino acid sequence of a protein when constructing cladograms.

Using your knowledge of the genetic code, suggest a reason for this. [1]

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16EP11

Turn over

(Question 4 continued)

Thomas Hunt Morgan investigated the inheritance of two genes in fruit flies (*Drosophila melanogaster*), which control body colour and wing length.

These genes are **not** found on the sex chromosomes.

- Allele **G** (grey body) is dominant to allele **g** (black body).
- Allele **L** (long wings) is dominant to allele **l** (short wings).

He crossed fruit flies that had grey bodies and long wings (heterozygous for both genes) with fruit flies that had black bodies and short wings.

The table shows the number of each offspring phenotype produced from these crosses.

Offspring phenotype	Observed number	Expected number
Grey body, long wings	965	
Grey body, short wings	206	
Black body, long wings	185	
Black body, short wings	944	
Total	2300	2300

- (b) (i) Calculate the number of individuals that would be expected for each offspring phenotype, if it is assumed that the two genes **do** assort independently.
Write these values in the table.

[1]

(This question continues on the following page)



(Question 4 continued)

The chi-squared test can be used to determine if there is a significant difference between the observed and expected numbers of offspring phenotypes.

The value of chi-squared for these results was calculated and found to be 1002.65. The critical values for chi-squared are shown in the table below.

Degrees of freedom	Probability (p)		
	0.10	0.05	0.01
1	2.71	3.84	6.64
2	4.60	5.99	9.21
3	6.25	7.82	11.34
4	7.78	9.49	13.28
5	9.24	11.07	15.09

- (ii) Justify the conclusions that can be drawn from the calculated and critical values for chi-squared.

[3]



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References:

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- 4.(a) and (b) Mueller, L.D. and Bitner, K., 2015. The Evolution of Ovoviviparity in a Temporally Varying Environment. *The American Naturalist*, 186, pp. 708–715. Source adapted.

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16EP15

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16EP16