Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Standard level
Paper 2

13 May 2025

Zone A morning | **Zone B** morning | **Zone C** morning

Candidate session number

1 hour 30 minutes

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

2225 – 6024

19 pages

Section A

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

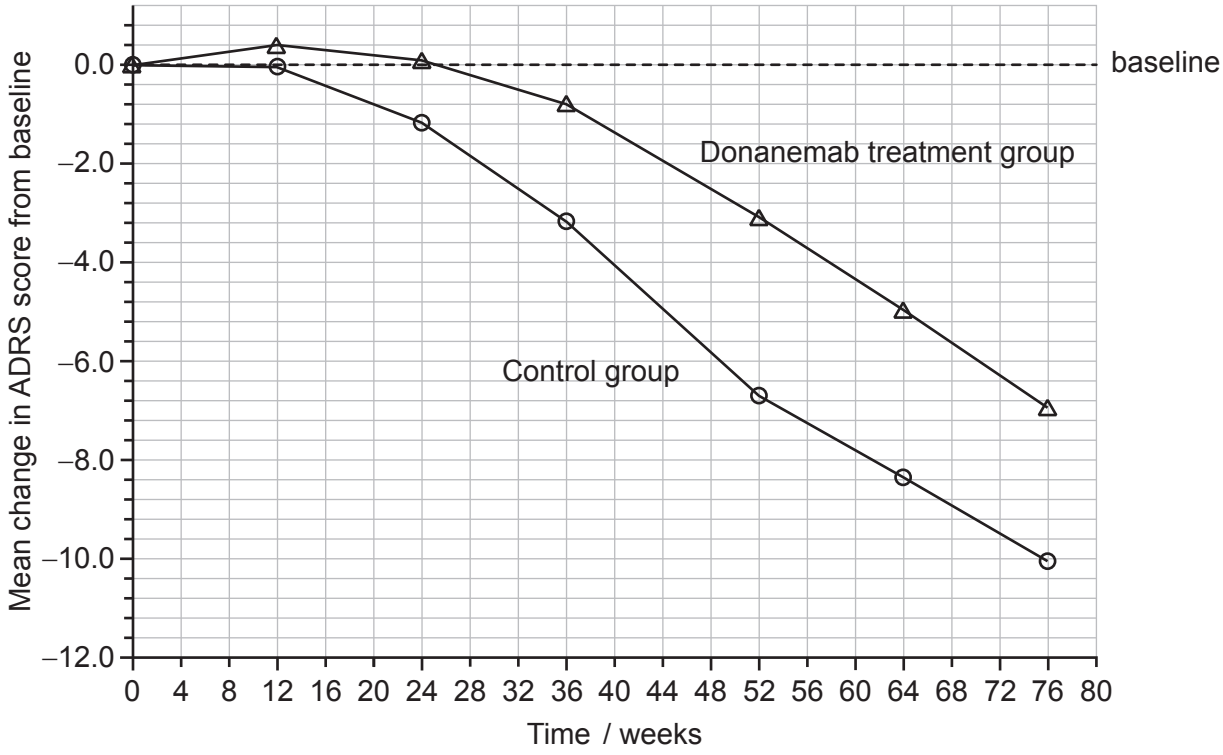
1. Dementia is a term used to describe a group of symptoms that are caused by a decline in brain function. People with dementia have problems with memory, language and behaviour.

Alzheimer's disease is the most common cause of dementia. Scientists investigated the effect of a drug called donanemab on people with Alzheimer's disease. They divided them into two groups:

- The treatment group received regular injections of a solution containing donanemab.
- The control group received regular injections of a solution without donanemab.

The scientists used the Alzheimer's Disease Rating Scale (ADRS) to measure brain function. The lower the score on this scale, the worse the brain function. The scientists calculated the mean ADRS score for each group at intervals over 76 weeks. They then calculated the mean change from their initial score at the start of the investigation (baseline).

Their results are shown in the graph.



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(Question 1 continued)

(a) Calculate the decrease in mean change in ADRS score from baseline between weeks 24 and 76 for the control group. [1]

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(b) Compare and contrast the data in the graph for the donanemab treatment group and the control group. [3]

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(c) In some drug trials, the control group is given a drug that is known to be effective against the disease. The treatment group is also given this drug, together with the new drug being tested. Suggest a reason for designing drug trials in this way for the control group. [1]

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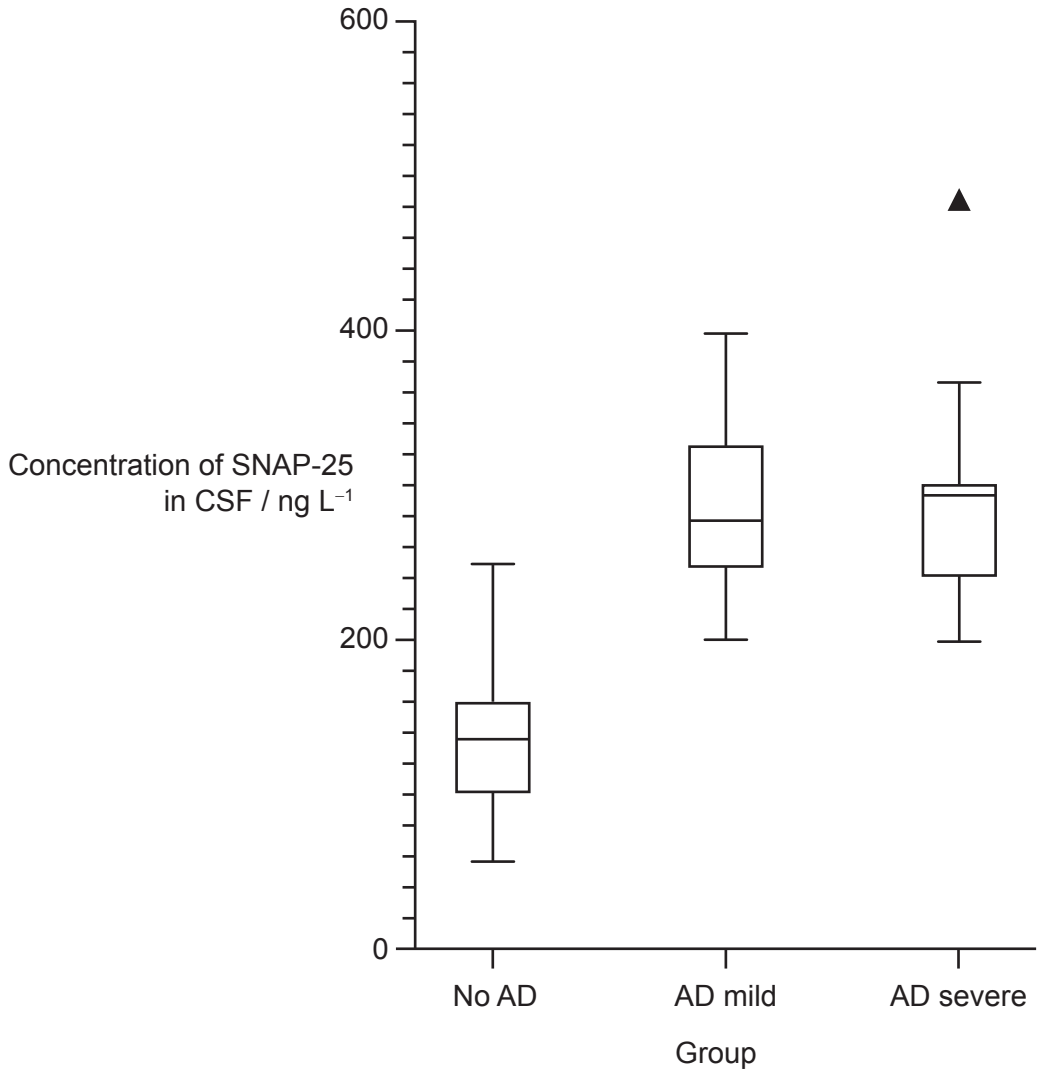
(Question 1 continued)

SNAP-25 (Synaptosomal-Associated Protein) is a protein found in the brain.

In a different investigation, scientists measured the concentration of SNAP-25 in the cerebrospinal fluid (CSF) of three groups of people:

- 36 people without Alzheimer's disease (No AD)
- 18 people with Alzheimer's disease who had mild dementia (AD mild)
- 24 people with Alzheimer's disease who had severe dementia (AD severe)

Their results are shown in the box-and-whisker plot.



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(Question 1 continued)

(d) Estimate the median concentration of SNAP-25 in CSF for the AD mild group. [1]

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(e) Using your knowledge of box-and-whisker plots, state what the data point shown as a triangle represents. [1]

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(f) Using all the information provided, evaluate the use of SNAP-25 concentration as a potential marker to help confirm a diagnosis of Alzheimer's disease. [3]

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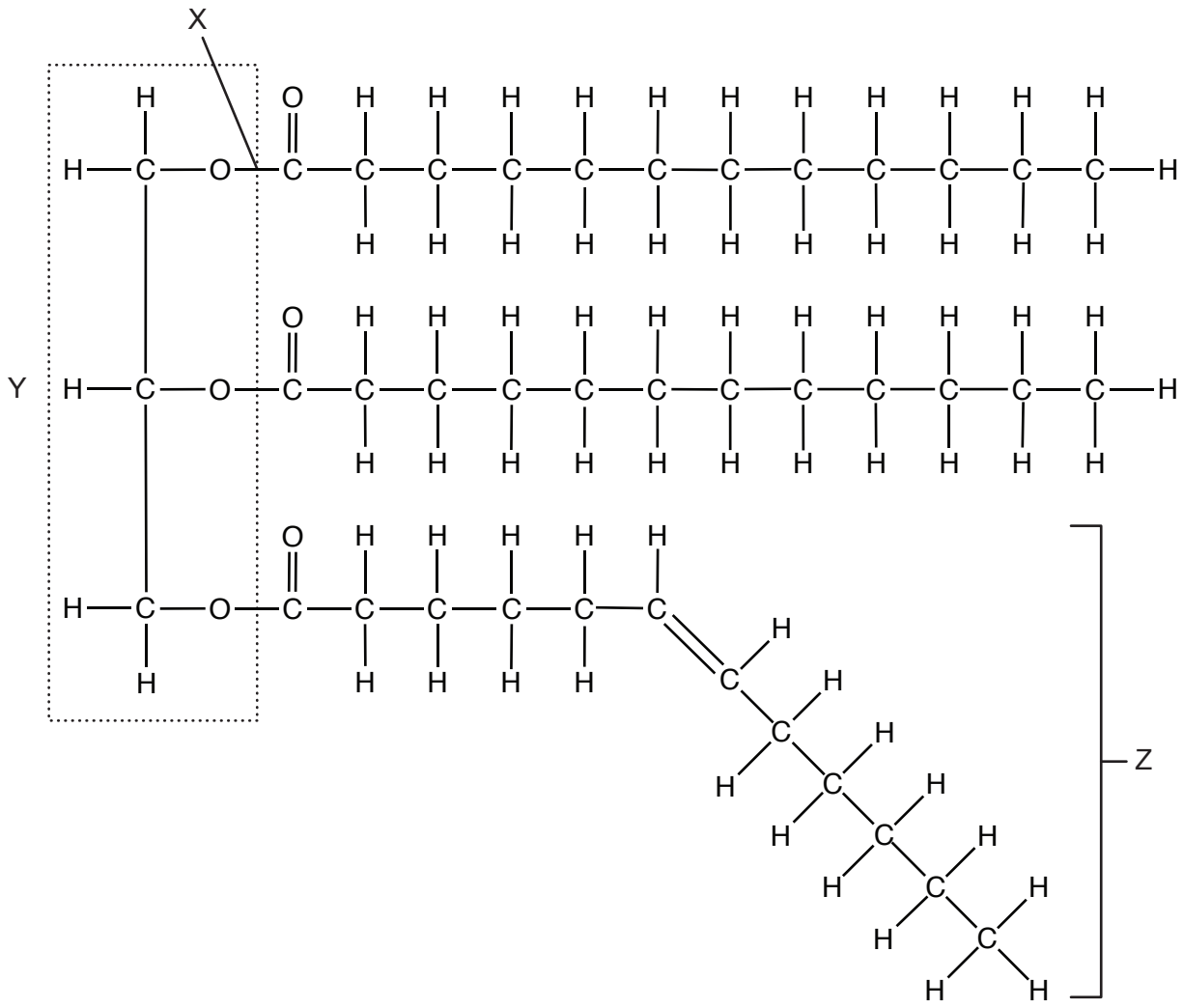
2. The diagram shows the structure of a triglyceride.



(a) Identify the type of reaction used to form the covalent bond indicated by X. [1]

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(b) Identify the molecule that was used to form part Y of the triglyceride. [1]

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(Question 2 continued)

(c) State the type of fatty acid shown as Z. [1]

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(d) Explain how the properties of triglycerides make them suitable for energy storage. [2]

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Answers written on this page
will not be marked.

3. (a) Describe the role of the EDGE of Existence programme. [2]

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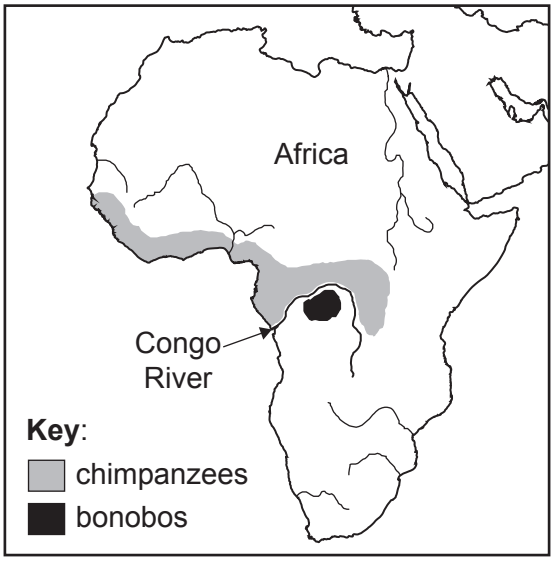
Chimpanzees and bonobos are different species of primate. It is thought that neither species can swim. The map shows the relative locations of chimpanzees and bonobos in Africa.



Evidence suggests that the level of the Congo River was lower during one period in the past. At this time, chimpanzees could have migrated across.

(b) Explain how bonobos could have evolved from chimpanzees by speciation. [3]

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4. (a) Define the term genotype. [1]

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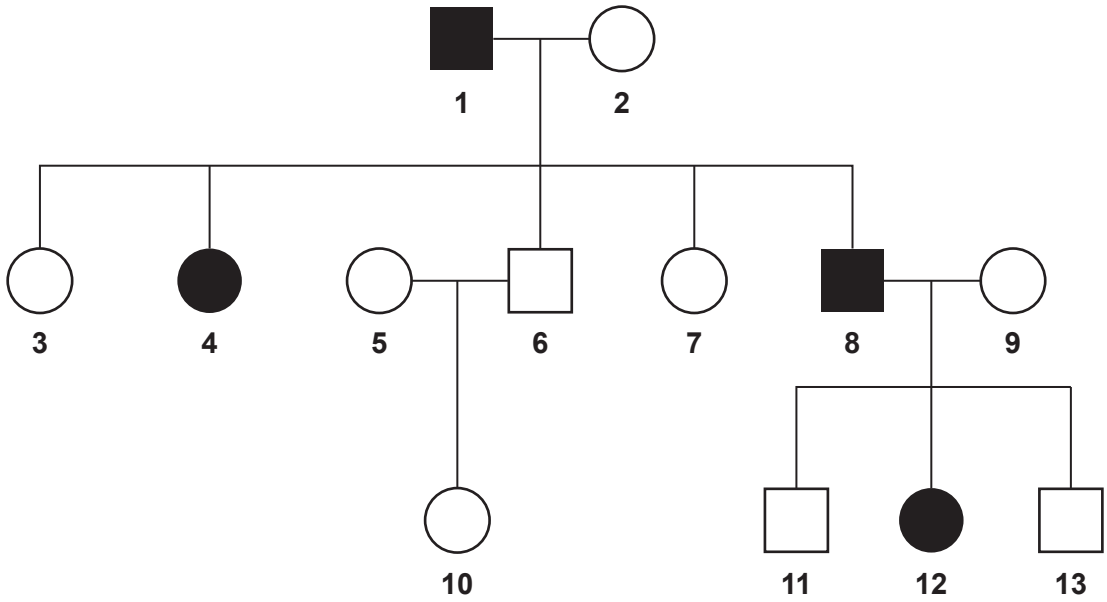
PKD (polycystic kidney disease) is an inherited disorder that causes the kidneys to become enlarged and lose function over time. PKD is caused by a dominant allele, **D**, which is **not** sex-linked.

The pedigree chart shows the inheritance of PKD in a family.



Key:

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(Question 4 continued)

(b) (i) Calculate the probability of individuals **1** and **2** having a child with PKD. [1]

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(ii) Explain how the pedigree chart shows that the dominant allele causing PKD is **not** on the X chromosome. [2]

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5. (a) Broad-spectrum insecticides kill many different species of insect. Narrow-spectrum insecticides only target a specific species of insect. Suggest **one** disadvantage of using a broad-spectrum insecticide. [1]

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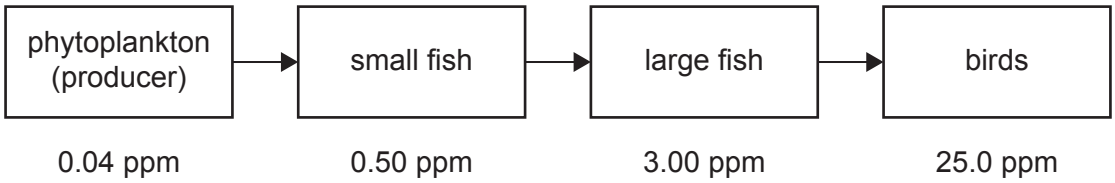
(b) The diagram shows the concentration of an insecticide, in parts per million (ppm), at different trophic levels of an aquatic food chain.



(i) Identify the trophic level of the large fish. [1]

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(ii) Explain the high concentration of insecticide in birds. [3]

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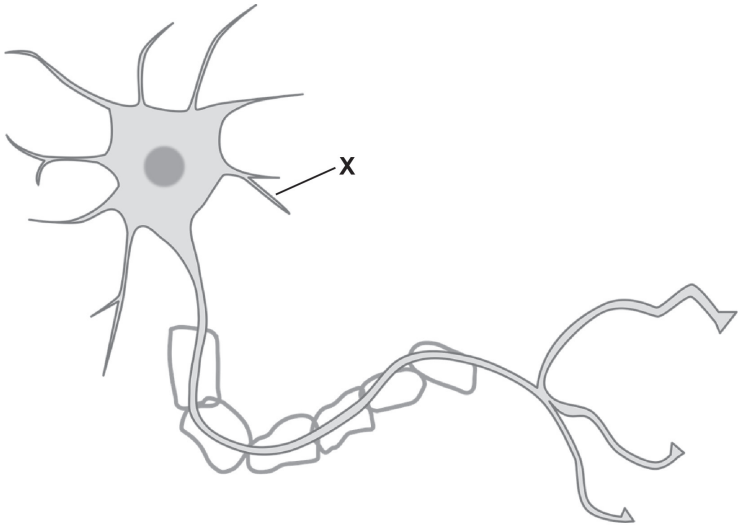
6. The diagram shows a neuron.



(a) Identify the structure and function for the part of the neuron labelled X. [2]

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(b) Describe how an excitatory postsynaptic potential is generated. [3]

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Section B

Answer **one** question. Up to one additional mark is available for the construction of your answer. Answers must be written within the answer boxes provided.

7. Mitosis produces genetically identical cells, which become specialized by expressing specific genes. This ensures that tissues and organs are adapted to their functions.

(a) Outline how the behaviour of chromosomes during mitosis ensures the production of genetically identical cells. [4]

(b) Describe how mRNA is produced in the nucleus. [4]

(c) Explain how the structures of arteries and veins are adapted to their functions. [7]

8. Cycles play an important role both within and outside the body.

(a) Outline the roles of progesterone in the menstrual cycle. [4]

(b) Describe the polymerase chain reaction (PCR). [4]

(c) Explain how carbon is recycled in a terrestrial ecosystem. [7]

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References:

1.a From *The New England Journal of Medicine*, Mark A. Mintun, Albert C.Lo, Cynthia Duggan Evans, Donanemab in Early Alzheimer's Disease. 384(18), pp. 1691–1704. Copyright © 2021 Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society.

1.d Öhrfelt, A., Brinkmalm, A., Dumurgier, J., et al., 2019. A Novel ELISA for the Measurement of Cerebrospinal Fluid SNAP-25 in Patients with Alzheimer's Disease. *Neuroscience* 420, pp. 136–144. https://doi.org/10.1016/j.neuroscience.2018.11.038. Source adapted.

3. *The regions of Africa where the chimpanzee and the bonobo are found*, n.d. [online] Available at: https://www.chrismadden.co.uk/where-are-we/chapters/chapter-16.html [Accessed 1 May 2024]. Source adapted.

6. Image by OpenClipart-Vectors from Pixabay. Source adapted