Index No.:_____ AM05/I.26s

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2026 SECOND SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	I
DATE:	31st August 2026
TIME:	9:00 a.m. to 12:05 p.m.

Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** questions. Write all your answers in the spaces provided in this booklet.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at **each** stage.
- The use of electronic calculators is permitted.

For examiners' use only:

Question	1	2	3	4	5	6	7	8	**Total**
Score									
Maximum	15	15	10	8	15	16	9	12	**100**

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1. The question is about nucleic acids and proteins.

   a. State the **THREE** main components of a DNA nucleotide.

_____

_____ (1.5)

   b. Name the type of bond formed when nucleotides join together to form a polynucleotide strand.

_____ (1)

   c. List the **FIVE** nitrogenous bases found in the nucleic acids of eukaryotic cells.

_____

_____ (2.5)

   d. Describe the secondary structure of proteins, referring to both the α-helix and β-pleated sheet.

_____

_____

_____

_____ (2)

   e. Explain how quaternary structure differs from tertiary structure in proteins.

_____

_____

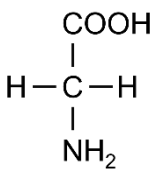
_____

_____ (2)

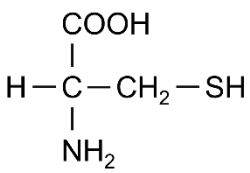
   f. Give **ONE** example of a protein that has a quaternary structure.

_____ (1)

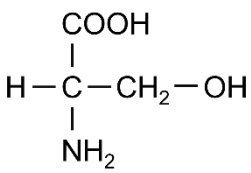
   Below are the structures of three amino acids.



glycine



cysteine



serine

g. Using two glycine molecules as an example, draw the structure of the dipeptide formed when two glycine molecules join together.

(2)

h. Explain why a mutation that replaces cysteine with serine may affect the function of a protein.

_____

_____

_____

_____

_____ (3)

(Total: 15 marks)

2. This question is about the evolutionary significance of some biological terms.

a. The endosymbiotic theory is used to explain the origin of mitochondria and plastids.

i. Describe what the endosymbiotic theory proposes.

_____

_____

_____ (2)

ii. State **TWO** pieces of evidence that support the endosymbiotic theory.

_____

_____

_____ (2)

Question continues on the next page.

iii. Explain how the organisms involved in the endosymbiotic origin of mitochondria benefited from the relationship.

_____

_____

_____ (2)

b. This question is about metameric segmentation.

i. Define metameric segmentation and explain its importance in animal body organisation.

_____

_____

_____ (2)

ii. Name **TWO** different phyla whose members exhibit metameric segmentation and name **ONE** species from each.

Phylum 1: _____ Species: _____

Phylum 2: _____ Species: _____

(2)

iii. Metameric segmentation is considered an important evolutionary adaptation. Discuss **TWO** advantages it provides for survival and adaptation.

_____

_____

_____ (2)

c. This question contains two incorrect statements about the cleidoic egg. For each statement, identify the biological mistake and explain why it is incorrect.

Statement 1: Whilst amphibians, birds, reptiles and some mammals all lay cleidoic eggs, fish do not require this adaptation since they live in water.

_____

_____

_____ (1.5)

Statement 2: Since the cleidoic egg is a closed environment, accumulation and excretion of waste generated by the developing embryo remains a problem.

_____

_____

_____ (1.5)

(Total: 15 marks)

3. This question is about homeostasis.

a. Figure 1 shows how the body temperature of two organisms of the same body size respond to changes in environmental temperature.

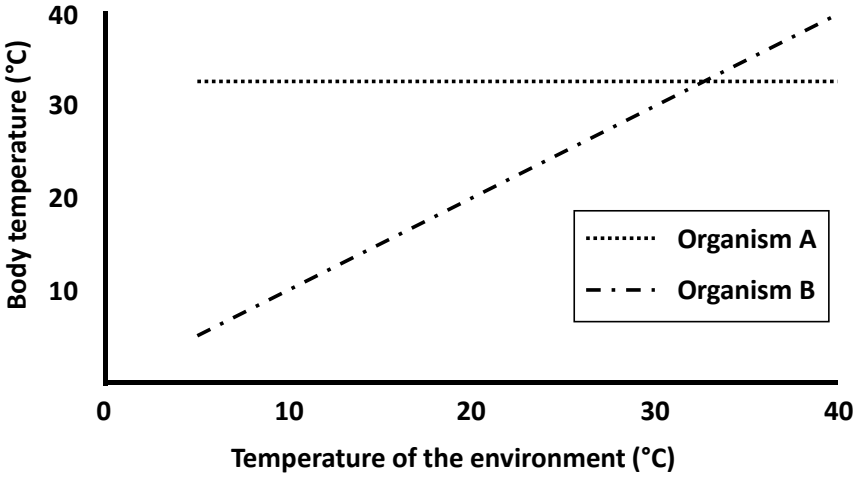


Figure 1: A graph showing changes to body temperature in response to changes in environmental temperature. (*Adapted from https://www.earthdate.org/files/000/003/165/EarthDate_314_C.pdf)*

Identify which organism is an ectotherm and which organism is an endotherm. Use the graph to justify your answer.

Ectotherm: _____

_____ (1)

Endotherm: _____

_____ (1)

Question continues on the next page.

b. Briefly explain why an ectothermic animal generally requires less food than an endothermic animal of similar size.

_____

_____

_____ (2)

c. A newly discovered mammal lacks sweat glands and lives in a desert environment. Propose and justify **ONE** structural, **ONE** behavioural, and **ONE** physiological adaptation that would enable it to regulate its body temperature effectively.

Structural adaptation: _____

_____

_____

_____(2)

Behavioural adaptation: _____

_____

_____

_____(2)

Physiological adaptation: _____

_____

_____

_____ (2)

(Total: 10 marks)

4. Summation allows neurons to integrate multiple inputs and determine whether an action potential is generated. Figure 2 shows three different scenarios, A, B, and C, involving inputs received by a neuron.

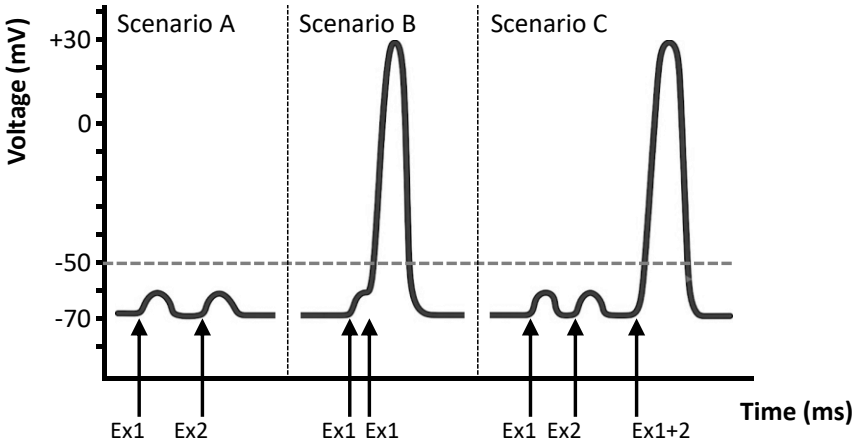


Figure 2: Changes in membrane potential of a receiving neuron in response to different patterns of synaptic input. Ex1 and Ex2 are EPSPs located at different locations on a neuron.
(Adapted from: https://www.medschoolcoach.com)

a. Define 'summation'.

_____

_____

_____

_____ (2)

b. Explain why no action potential was generated in Scenario A.

_____

_____

_____

_____ (2)

c. Identify the type of summation occurring in Scenario B. Explain your answer using information from the figure.

_____

_____

_____

_____ (2)

Question continues on the next page.

d. Scenario C demonstrates another type of summation. Identify this type of summation and explain the role of different synapses in generating an action potential.

_____

_____

_____

_____ (2)

(Total: 8 marks)

5. This question is about immunity in humans.

The graph below (Figure 3) shows the typical change in antibody concentration following vaccination. Measles is a viral disease. When the measles vaccine is administered, the body produces antibodies, typically resulting in the pattern shown below. In this example, the first vaccination was given on day 0 and the second (booster) vaccination was given on day 20.

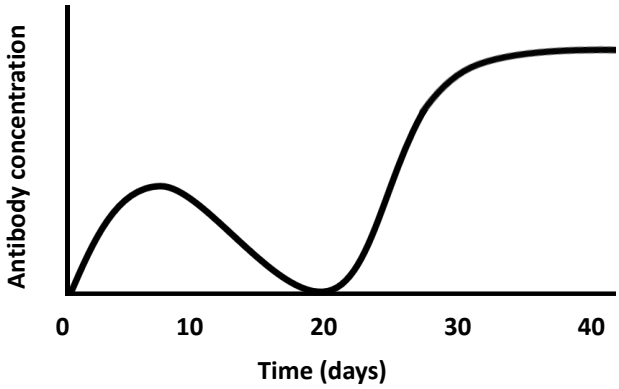


Figure 3: Changes in antibody concentration following the first vaccination on day 0 and the second (booster) vaccination on day 20.
(Adapted from: https://www.bbc.co.uk/bitesize)

a. Which line of defence is responsible for producing antibodies to fight infections?

_____ (1)

b. Which cells produce antibodies?

_____ (1)

c. Briefly explain the function of antibodies in the body.

_____

_____

_____ (2)

d. Does the graph illustrate active immunity or passive immunity? Give **ONE** reason for your answer.

_____

_____

_____ (2)

e. With reference to Figure 3, explain the following observations:

i. Observation 1: The primary response produced only a low concentration of antibodies.

_____

_____

_____ (2)

ii. Observation 2: The secondary response produced a much higher concentration of antibodies than the primary response.

_____

_____

_____ (2)

iii. Observation 3: The antibody concentration remained high after the secondary response.

_____

_____

_____ (2)

f. Both measles and influenza are caused by viruses. Suggest why the measles vaccine is usually given only once (with a booster in childhood) and provides long-term protection, whereas the influenza vaccine is recommended every year.

_____

_____

_____

_____

_____ (3)

(Total: 15 marks)

Please turn the page.

6. This question is about plants and photosynthesis.

a. Three plant species using different photosynthetic pathways (C_3, C_4 and CAM) are found growing in different environments. Plant A is a C_3 plant; Plant B is a C_4 plant; and Plant C is a CAM plant.

i. Plant A (C_3) and Plant B (C_4) are exposed to several days of high temperatures (38 °C) and limited water availability. Explain why the rate of photorespiration is expected to increase in Plant A but remain relatively low in Plant B.

_____

_____

_____ (2)

ii. A farmer wishes to grow crops in a region close to a desert where temperatures are high, sunlight intensity is very high, and water availability is extremely limited. Recommend whether Plant A, Plant B or Plant C would be most suitable for this environment. Justify your answer by considering the environmental conditions and photosynthetic pathway used.

_____

_____

_____

_____

_____ (3)

iii. Plant B has a specialised internal leaf structure containing mesophyll cells and bundle sheath cells with different types of chloroplasts. Explain how this leaf structure increases the efficiency of photosynthesis in Plant B.

_____

_____

_____

_____

_____ (3)

b. Researchers identify a mutant plant in which the enzyme responsible for regenerating ribulose bisphosphate (RuBP) does not function efficiently.

Compared with a non-mutant plant grown under identical conditions, predict how the rate of carbon fixation and carbohydrate production would differ in the mutant plant. Explain your reasoning.

_____

_____

_____

_____

_____ (3)

c. A researcher illuminates isolated chloroplasts using blue, green and red light of equal intensity. Results are indicated in Table 1.

Table 1: Light colour used to illuminate chloroplasts and the relative rate of photosynthesis.

Light colour	Relative rate of photosynthesis
Blue	High
Green	Very low
Red	High

Explain why different wavelengths of light produce different rates of photosynthesis.

_____

_____

_____ (2)

d. During another experiment, a chemical blocks the transfer of electrons between carriers in the electron transport chain. Explain how this would affect ATP production during the light-dependent reaction.

_____

_____

_____

_____

_____ (3)

(Total: 16 marks)

Please turn the page.

7. This question is about different types of plants and the adaptations that allow them to survive in the environments in which they live.

   a. Each description below refers to a type of plant based on the environment in which it lives and its adaptations. Identify the type of plant described in each case.

      i. A plant that lives in environments with a moderate supply of water. It does not have specialised structural adaptations to conserve water or remove excess salts.

_____ (0.5)

      ii. A plant that has adaptations that allow it to tolerate or remove excess salt from its tissues.

_____ (0.5)

      iii. A plant that lives in water or in very wet environments. It may have aerenchyma to aid buoyancy and gas exchange.

_____ (0.5)

      iv. A plant that lives in dry conditions where water is scarce.

_____ (0.5)

   b. Some plants are adapted to dry environments where water is scarce. Complete the table below by either naming the structural adaptation or explaining how it helps to conserve water.

Table 2: Adaptations of plants living in dry environments where water is scarce.

Adaptation	**Importance of the adaptation**
Thick waxy cuticle	
Rolled leaves	
Sunken stomata	
	Structures that trap a layer of moist air around the leaf surface and stomata, reducing the rate of transpiration.
	Allows the plant to reach water deep in the soil.

(5)

c. Two plant species grow in different habitats. Species D lives in a freshwater marsh, while Species E lives in an arid desert. Analysis shows that the root cells of Species E have a lower solute potential than those of Species D. Explain why this difference is advantageous for Species E.

_____

_____

_____ (2)

(Total: 9 marks)

8. Describe the biotechnology technique(s) used in each of the following cases.

a. A scientist joins DNA fragments from two different organisms to create a single DNA molecule.

_____

_____

_____ (1.5)

b. A pulse of electricity is used to transfer foreign DNA into bacterial cells.

_____

_____

_____ (1.5)

c. A human mRNA molecule is converted into DNA before it can be inserted into bacteria for protein production.

_____

_____

_____ (1.5)

d. After bacteria take up plasmids, only those carrying an antibiotic-resistance gene are allowed to grow.

_____

_____

_____ (1.5)

Question continues on the next page.

e. A laboratory separates DNA fragments by size to compare different samples.

_____

_____

_____ (1.5)

f. A forensic scientist compares DNA from a crime scene with samples from three suspects to identify the person who left the evidence.

_____

_____

_____ (1.5)

g. Researchers produce many copies of a DNA fragment recovered from ancient human remains.

_____

_____

_____ (1.5)

h. A patient with X-linked severe combined immunodeficiency (SCID) receives genetically modified bone marrow stem cells carrying a healthy copy of the defective gene.

_____

_____

_____ (1.5)

(Total: 12 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2026 SECOND SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	II
DATE:	1st September 2026
TIME:	9:00 a.m. to 12:05 p.m.

Directions to Candidates

- Answer the question in Section A, any **TWO** questions from Section B and **ONE** question from Section C. Write all your answers in the separate booklet provided.
- If more than two questions from Section B are attempted, only the first two answers shall be taken into consideration.
- If more than one question from Section C is attempted, only the first answer shall be taken into consideration.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at each stage.
- The use of electronic calculators is permitted.

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SECTION A

1. Read the following extract carefully, and using the information provided and your knowledge of biology, answer the questions that follow. The numerals in the left-hand margin are the line numbers.

Glimmers of hope for genetic diversity amid general global decline

Genetic diversity is essential for the survival of populations because it provides the variation needed for species to respond to environmental change. Within a population, individuals may carry different alleles that affect their ability to survive under particular conditions.

For example, Golden Kelp (*Ecklonia radiata*) is generally adapted to cooler waters, but some individuals carry genetic variants that allow them to tolerate higher temperatures. When a severe marine heatwave affected the coast of Western Australia in 2011, individuals with these variants were more likely to survive and reproduce. Over generations, the frequency of these alleles increased, allowing the population to become better adapted to warmer conditions.

However, many species are experiencing a decline in genetic diversity due to habitat loss, population decline and isolation. Small populations may be particularly vulnerable because individuals are more likely to interbreed with relatives, reducing survival and reproductive success.

One conservation method used to increase genetic diversity is supplementation, where individuals are introduced into an existing small population. For example, conservationists moved female South Island Robins (*Petroica australis*) between isolated islands in New Zealand. Researchers found differences in survival and reproductive success between offspring from mixed-origin populations and those from isolated populations. Thus, the movement of individuals between populations can introduce new alleles and increase gene flow. This may reduce the effects of inbreeding by increasing genetic variation within a population. However, conservationists must consider that populations may have become adapted to their local environment.

Habitat restoration is another approach used to protect genetic diversity. Restoring forests, wetlands, and natural ecosystems can allow populations to increase and individuals from different areas to interact. For example, restoring suitable habitat has helped the recovery of the Greater Prairie-Chicken (*Tympanuchus cupido*), which had lost much of its natural habitat.

Conservationists may also establish new populations through conservation introductions or reintroductions. In Western Australia, Golden Bandicoots (*Isoodon auratus*) from a genetically healthy island population were introduced to three new sites where the species was absent. After six generations, genetic diversity remained similar to that of the original population, suggesting that careful selection of individuals helped maintain variation.

Overall, many species continue to experience losses in genetic diversity, but carefully planned conservation strategies can help maintain variation within populations. This increases the likelihood that species will survive future environmental changes

Adapted from: Largest study on genetic diversity finds glimmers of hope amid general global decline https://www.australiangeographic.com.au/news/2025/01/largest-study-on-genetic-diversity-finds-glimmers-of-hope-amid-general-global-decline/

a. Define 'genetic diversity'. (1)

b. Golden Kelp populations (line 4) contain individuals with different alleles. Explain how this genetic variation may have arisen. (2)

c. A scientist claims that "the heatwave caused Golden Kelp to mutate and become adapted to warmer water". Explain why this statement is incorrect. (3)

d. The passage describes how small populations may experience reduced genetic diversity. Explain why small populations are particularly vulnerable to loss of genetic diversity. (4)

e. Conservationists moved female South Island Robins (line 15) between isolated islands. Explain how this action could increase genetic diversity on island populations. (2)

f. Suggest **ONE** possible disadvantage of introducing individuals from another population during conservation programmes. (2)

g. Golden Bandicoots (line 26) were introduced to new locations from an island population. Explain why the genetic diversity of the new populations depends on the genetic characters of the individuals originally introduced. (2)

h. Scientists studying the isolated robin populations described in the extract concluded that these populations were unlikely to be in Hardy–Weinberg equilibrium. Explain why, referring to evidence from the extract. (2)

i. A storm reduced an isolated robin population to only a few surviving individuals before the population recovered. Explain how this event could affect the genetic diversity of the population. (2)

j. A student suggests that any change in allele frequencies within a population is caused by natural selection. Using **TWO** examples from the extract, explain why this statement is not always correct. (2)

k. A conservation programme increases the number of individuals in an endangered population, but genetic diversity continues to decline. Using information from the passage, suggest possible explanations. (2)

l. Name **TWO** human activities that can cause habitat fragmentation, leading to the isolation of populations (line 10). (1)

(Total: 25 marks)

Please turn the page.

SECTION B
Answer any TWO questions from this section; your answers should take the form of essays. Each question carries twenty-five marks.

1. Discuss the roles of mRNA, tRNA and ribosomes in protein synthesis.

2. Analyse how the respiratory systems of insects, bony fish and mammals demonstrate adaptations that optimise gaseous exchange according to Fick's Law of diffusion.

3. Discuss fertilisation and early development of the human embryo, including implantation and placenta formation.

4. Discuss how different types of skeletons influence movement in animals.

(Total: 50 marks)

SECTION C
Answer ONE question from this section.

1. Use your knowledge of biology to explain the following statements related to DNA:

   a. DNA strand direction influences how the strand is replicated. (5)

   b. DNA replication needs enzymes to occur. (5)

   c. DNA has characteristics that minimise errors during DNA replication. (5)

   d. Point mutations may result in silent mutations, whereas frameshift mutations cannot be considered silent mutations. (5)

   e. Experimental evidence demonstrated that DNA replication is semi-conservative. (5)

(Total: 25 marks)

OR

2. Use your knowledge of biology to explain the following statements:

   a. Oligochaetes and polychaetes are members of the same phylum but show clear differences in body structure and organisation. (5)

   b. Differences in tagmatisation and appendages can be used to distinguish between major arthropod groups. (5)

   c. Echinoderms exhibit secondary radial symmetry. (5)

   d. Unicellular and multicellular fungi share common biological characteristics. (5)

   e. Polypodiophytes show adaptations that are intermediate between those of bryophytes and flowering plants. (5)

(Total: 25 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2026 SECOND SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	III
DATE:	2nd September 2026
TIME:	9:00 a.m. to 10:35 a.m.

Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** questions. Write all your answers in the spaces provided in this booklet.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at each stage.
- The use of electronic calculators is permitted.

For examiners' use only:

Question	1	2	3	**Total**
Score				
Maximum	18	19	13	**50**

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1. Ecological investigation of coastal plants.

a. A botanist investigated the populations of three plant species in a coastal habitat covering an area of 8000 m^2. The site was surveyed using ten randomly placed quadrats. Square quadrats measuring 2 m x 2 m were used to collect the data. For each quadrat, the botanist counted and recorded the number of individuals of each of the three plant species. The results are presented in Table 1.

Table 1: The number of individuals of each species within each quadrat.

Species	**Quadrant number**									
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Crithmum maritimum	0	3	0	2	2	0	2	0	3	2
Thymbra capitata	2	1	0	6	5	2	0	1	0	3
Euphorbia dendroides	0	0	2	2	3	0	2	0	1	0

i. Calculate the percentage of the 8000 m^2 study area sampled using the ten quadrats. Show your working.

_____

_____

_____

_____ (2)

ii. Calculate the population size of *Thymbra capitata* in this habitat. Show your working.

_____

_____

_____

_____ (2)

iii. Quadrat 4 and Quadrat 5 are two quadrats that represent the three species being studied. Calculate Simpson's Reciprocal Index of Diversity (D) separately for Quadrat 4 and Quadrat 5 using the formula below:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

D = Simpson's Reciprocal Index of Diversity
N = the total number of individuals of all species present in the quadrat
Σ = sum of
n = the number of individuals of one species in the quadrat

Quadrat 4: _____

_____

_____

_____

Quadrat 5: _____

_____

_____

_____ (3)

iv. Simpson's Reciprocal Index calculates biodiversity by considering both species richness and the relative abundance of individuals within each species. Based on this index, what can you conclude about the diversity of the plant species recorded in Quadrat 4 and Quadrat 5?

_____

_____

_____ (2)

v. State **TWO** assumptions made when estimating the population size of *Thymbra capitata* using quadrat sampling.

_____

_____

_____

_____ (2)

vi. Suggest **TWO** limitations of the quadrat sampling method used in this investigation.

_____

_____

_____

_____ (2)

Question continues on the next page.

vii. Compare the use of a belt transect and random quadrat sampling for investigating plant distribution in the area under study. In your answer, explain why a belt transect is the more suitable method.

_____

_____

_____

_____

_____

_____ (3)

b. The botanist then examined the morphology of *Thymbra capitata.*

Figure 1: A photograph of *Thymbra capitata*
(source: https://www.florealpes.com/)

Based on the image provided in Figure 1, describe **ONE** visible feature that indicates that this plant is adapted to survive in a dry environment.

_____

_____

_____

_____ (2)

(Total: 18 marks)

2. Sucrase is an enzyme that catalyses the hydrolysis of sucrose. A student carried out an investigation to determine how changing the concentration of the sucrose affects the activity of sucrase.

In the first part of her experiment, the student prepared six test tubes, each containing 5 cm^3 of sucrose solution at different concentrations. These test tubes were placed in a water bath maintained at 37 °C for 10 minutes. After this time, 5 cm^3 of sucrase solution, also at 37 °C, was added to each test tube. The contents of each test tube were mixed using a glass rod.

Five minutes later, the test tubes were transferred to another water bath maintained at 90 °C. An equal volume of Benedict's solution was then added to each test tube. The student recorded the time taken for the solution in each test tube to turn green.

The sucrose concentrations used and the recorded times are shown in Table 2.

Table 2: Sucrose concentration, time for first green colour to appear and rate of hydrolysis.

Concentration of sucrose (gdm^{-3})	**Time taken for green colour to become visible (s)**	**Rate of sucrose hydrolysis (s^{-1})**
5	98	
20	51	
40	32	
60	26	
80	24	
100	25	

a. Suggest **ONE** reason why all the test tubes were placed in a water bath at 37 °C for 10 minutes before the sucrase solution was added.

_____

_____ (1)

b. Suggest **TWO** reasons why the final stage of the experiment was conducted in a water bath at 90 °C.

_____

_____

_____

_____ (2)

Question continues on the next page.

c. Name **ONE** other variable, other than temperature, that was kept constant and explain why it was important to keep this variable constant during this experiment.

_____

_____

_____ (2)

d. Benedict's solution was used to detect reducing sugars produced during the reaction. Name the reducing sugar(s) produced when sucrose is hydrolysed by sucrase.

_____ (1)

e. Work out the rate of sucrose hydrolysis, by filling the third column of Table 2. *(The space provided below is for your working.)*

_____

_____

_____

_____ (2)

f. On the graph paper on page 7, draw a graph to show the effect of substrate concentration on the rate of sucrose hydrolysis. (5)

g. Explain the results obtained.

_____

_____

_____

_____

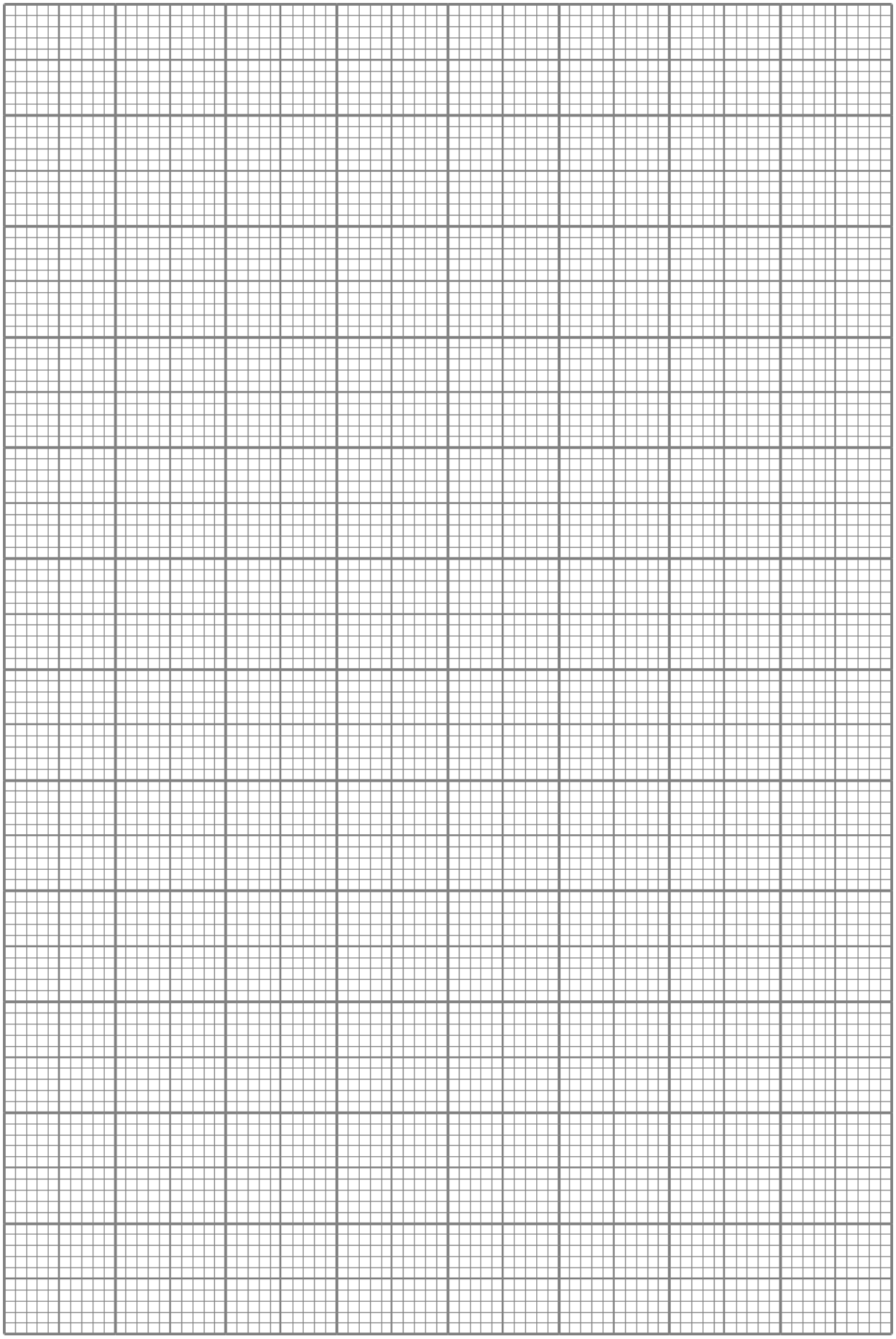
_____

_____ (3)

h. Suggest **ONE** way in which the accuracy of these results could have been improved.

_____

_____ (1)



Question continues on the next page.

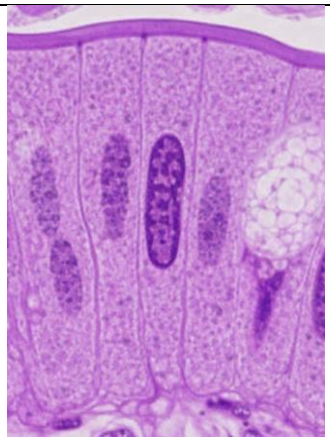
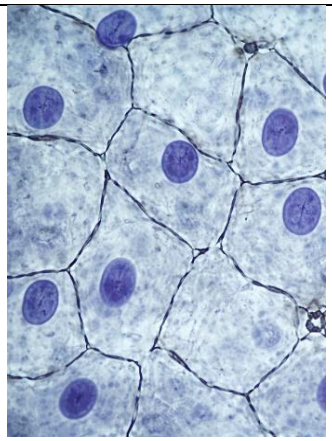
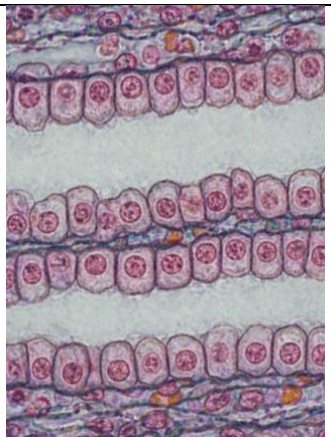
i. For the second part of the experiment, the student repeated the procedure but added 0.5 cm^3 solution containing the competitive inhibitor acarbose to each mixture. On the graph drawn on page 7, sketch a plot showing the rate of sucrose hydrolysis when acarbose is present. Label this newly sketched line as *Acarbose Reaction.* (2)

(Total: 19 marks)

3. During a practical biology session, different students were assigned different investigations involving animal and plant tissues.

a. The first student examined photomicrographs (Figure 2 to Figure 4) showing three different types of human epithelial tissue.

Complete the table by identifying each type of epithelial tissue shown. For each epithelial tissue, state **ONE** structural characteristic that is related to its function and name **ONE** location in the human body where it is found.

Photomicrograph	 Figure 2	 Figure 3	 Figure 4
Type of epithelium			
Characteristic structural feature related to function			
One location in the human body			

(source: https://www.gettyimages.com/)

(6)

b. The second student examined a human vertebra to investigate its structure.

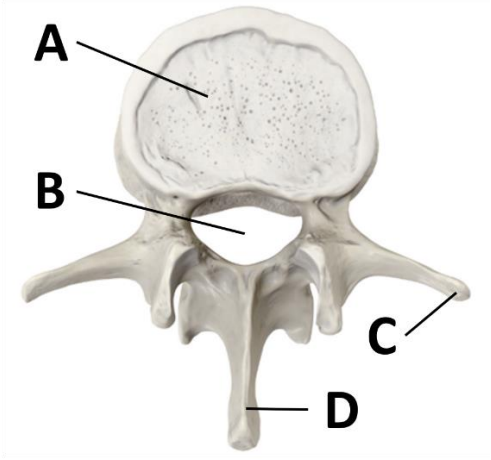


Figure 5: A top view of a lumbar vertebra
(Adapted from: https://anatomytool.org)

Name the structures labelled A to D on Figure 5.

A: _____ B: _____

C: _____ D: _____ (2)

c. The third student prepared a root tip squash using onion roots to observe the different stages of mitosis. Outline the procedure used to prepare a root tip squash suitable for observing the stages of mitosis under a light microscope.

_____

_____

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_____

_____ (5)

(Total: 13 marks)

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L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2026 SECOND SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IV – *Practical*
DATE:	27th August 2026
TIME:	1 hour 35 minutes

Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** parts of the question. Write all your answers in this booklet. Drawings of biological material and graphical representations of data are to be made on the appropriate pages within this booklet.
- The marks allotted to parts of question are indicated.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at each stage.
- The use of electronic calculators is permitted.

For examiners' use only:

Question	**Total**
Score	
Maximum	**40**

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1. The concentration of reducing sugars present in beverages can be estimated using Benedict's reagent. In this investigation, you are required to design a method to estimate the concentrations of reducing sugars in two soft drink samples. The samples include a regular soft drink and a low-calorie alternative. Unlike the regular drink, the low-calorie version contains the artificial sweetener aspartame.

   You are provided with the following materials:
   - 6% glucose solution (labelled **Glucose solution**);
   - Soft drink samples (labelled **Sample A** and **Sample B**);
   - Benedict's reagent;
   - distilled water;
   - test tubes;
   - other laboratory apparatus as required.

a. State the objective of this investigation.

_____

_____(1)

b. Suggest a suitable null hypothesis for this investigation.

_____

_____(1)

c. Using the glucose solution provided, prepare three glucose standards of different concentrations. Transfer each prepared solution to the small cups provided. Calculate the volume of 6% glucose solution and distilled water required for each preparation by completing the table below.

Concentration of glucose solution (%)	**Volume of 6% glucose solution added (mL)**	**Volume of distilled water added (mL)**	**Total volume (mL)**
6			18
4			18
2			18

(3)

d. State and explain **THREE** variables that must be kept constant during this experiment to ensure comparable results.

Variable 1: _____

_____

_____

_____ (2)

Variable 2: _____

_____

_____

_____ (2)

Variable 3: _____

_____

_____

_____ (2)

e. Devise and describe an experimental procedure that can be used to estimate the concentration of reducing sugars in each of the soft drinks provided by comparing them to the glucose standards prepared in part (c).

Your procedure should include the following:

- the procedure to test for reducing sugars;
- the preparation of a negative control;
- the assessment of concentration of reducing sugars in each sample of soft drink.

It is recommended that for each test you use 3 mL of sample to 3 mL of Benedict's reagent.

_____

_____

_____

_____

_____

_____

Question continues on the next page.

(12)

Carry out the investigation that you devised in part (e) and record your results in part (f).

f. Record your results in the space below. *Marks will be awarded for the structure and the organisation of the results obtained.*

(6)

Question continues on the next page.

g. Describe the pattern observed in your results.

_____

_____

_____

_____

_____

_____

_____(4)

h. State a conclusion about the concentrations of reducing sugars in Samples A and B, using evidence from your results.

_____

_____

_____(2)

i. Identify **TWO** sources of error that could have affected your results.

Source of error 1: _____

_____(1)

Source of error 2: _____

_____(1)

j. Describe **ONE** modification that would improve the reliability and accuracy of this investigation.

_____

_____

_____

_____

_____(3)

(Total: 40 marks)

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