Index No.:_____ AM 05/I.18m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2018 FIRST SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	I
DATE:	7th May 2018
TIME:	4:00 p.m. to 7:05 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	9	**Total**
Score										
Maximum	9	10	12	14	10	10	10	13	12	**100**

1. This question concerns the cell.

a. Give **THREE** functions of integral proteins within the plasma membrane.

_____

_____

_____ (3)

b. What is the main function of the nucleolus?

_____

_____

_____ (1)

c. How many centrioles are there in animal cells and what is their role in nuclear division?

_____

_____

_____ (2)

d. Which organelle is responsible for the lysis of worn out organelles?

_____ (1)

e. Give a brief description of the golgi apparatus in animal cells. (An annotated diagram is also accepted.)

_____

_____

_____ (2)

(Total: 9 marks)

2. This question is about biomolecules and enzymes.

The human body contains a concoction of biomolecules interacting together to both constitute the organism as well as render it functional.

a. The most abundant biomolecule is water as it makes up approximately 70% of the human body. State **TWO** properties of water and explain the biological importance of each of these properties.

(4)

b. Water is associated with the building up and the breaking down of protein molecules. Explain this statement.

(2)

c. Proteins make up enzymes which are of fundamental importance to life as they are biological catalysts.

i. Certain enzymes are subject to allosteric regulation. Define allosteric regulation.

(1)

Question continues on next page

ii. Explain the role of phosphofructokinase in regulating respiration.

(3)

(Total: 10 marks)

3. This question is about heterotrophic nutrition.

a. Consider Figure 1 which is showing the histology of the ileum wall.

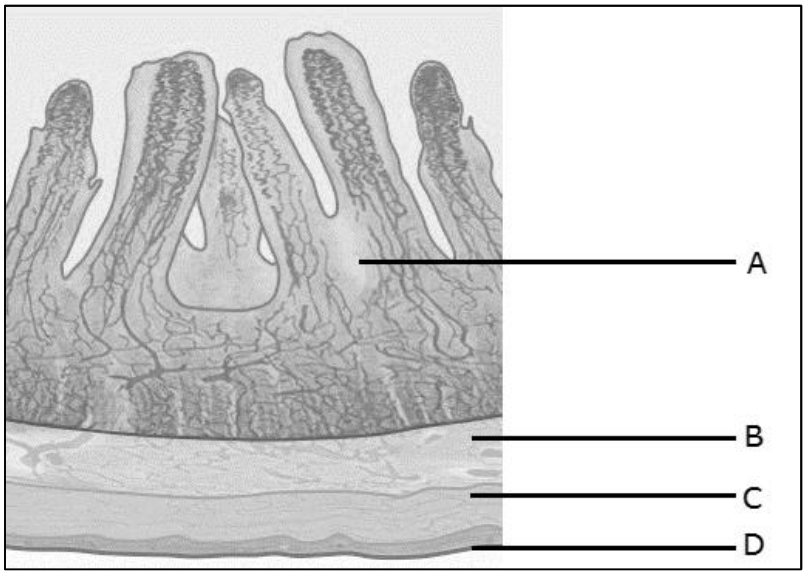

Figure 1: Longitudinal cross section of the ileum.
(Source: http://ib.bioninja.com.au)

Label structures A – D:

A. _____

B. _____

C. _____

D. _____

(2)

b. Explain why each villus in the small intestine has a network of capillaries and how this affects the concentration gradient inside the villus.

(2)

c. A ruminant is an animal which has a complicated digestive system in which the "stomach" typically has several chambers. List these **FOUR** chambers and briefly state their function in the digestive process of ruminants.

(8)

(Total: 12 marks)

Questions continue on next page

4. This question is about transmission of nerve impulses in humans.

Table 1 below shows information about two reflex actions – a monosynaptic and a polysynaptic reflex – taken from a healthy individual.

Table 1: Speed of impulses in two reflex actions

	Length of neurons involved (cm)	**Time taken for reflex action (ms)**	**Speed of impulse (cm/ms)**
Reflex A	120	40	
Reflex B	95	50	

a. List and explain **TWO** advantages of having chemical synapses in the nervous system.

_____

_____ (4)

b. Give **ONE** example of a monosynaptic and **ONE** example of a polysynaptic reflex.

Monosynaptic reflex:

_____ (1)

Polysynaptic reflex:

_____ (1)

c. Calculate the speed of impulse for each of the two reflexes A and B. Present your answers in Table 1 above. (2)

d. Which of the two reflexes (A or B) is most probably polysynaptic? Explain.

_____

_____

_____

_____ (3)

e. How might the speed of impulse be different if readings were taken from a person suffering from Guillain-Barre syndrome (a disorder that causes damage to myelin sheaths)? Explain.

(3)

(Total: 14 marks)

5. This question is about Lupus Nephritis, a disease affecting the excretory system.

Lupus Nephritis is an inflammation of the kidney that is caused by Systemic Lupus Erythematous (SLE). SLE, commonly referred to as Lupus, is an autoimmune disease. Up to 60% of Lupus patients will develop Lupus Nephritis.

a. What is an autoimmune disease?

(1)

Patients who suffer from Lupus may expose nuclear self-antigens to the immune system on MHC class II proteins of their antigen-presenting cells.

b. Give **ONE** example of an antigen-presenting cell.

(1)

c. To which cells of the immune system do MHC class II proteins normally present antigens?

(1)

d. Give **TWO** differences between MHC class I glycoproteins and MHC class II glycoproteins.

(2)

Question continues on next page

In the kidney, two processes involved in the formation of urine are ultrafiltration and selective reabsorption. A urine sample taken from a person suffering from Lupus Nephritis indicated presence of red blood cells and proteins.

e. Is the presence of red blood cells and proteins in urine normal? Explain why.

_____

_____ (1)

f. Figure 2 shows a nephron taken from the kidney of a healthy person.

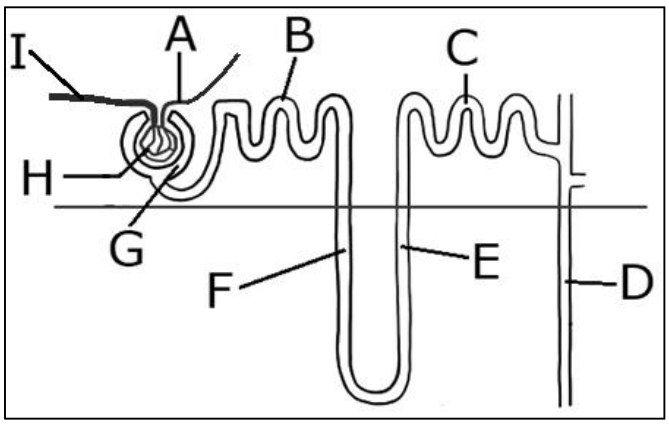

Figure 2: The nephron
(adapted from http://ibbiologyhelp.com/AnimalPhysiology/thekidneya.html)

i. Fill in the following table with the appropriate letter from the diagram above.

Region	Letter
where ultrafiltration occurs	
where all glucose and amino acids are actively reabsorbed	
that only becomes permeable to water in the presence of ADH	
that is constricted when glomerular filtration rate (GFR) needs to be lowered	

(2)

ii. Explain why the filtrate in C is always hypotonic to blood.

_____

_____

_____ (2)

(Total: 10 marks)

6. This question is about biotechnology.

Aflatoxin is produced by the fungus *Aspergillus flavus* when it invades peanuts. The presence of this toxin in even low amounts makes peanuts unacceptable for consumption due to its toxic and carcinogenic properties. Researchers are devising a multi-faceted plan by which genetic engineering can be used to protect peanuts from fungal infections.

a. What is genetic engineering?

_____

_____(1)

One of the strategies adopted to reduce aflatoxin contamination was to introduce defensin genes coding for antifungal proteins from *Medicago sativa* (Alfalfa) into peanut plants.

b. Give the steps involved in extraction and identification of the genes coding for defensin.

_____

_____

_____(3)

c. Which technique could be used to produce multiple copies of the isolated genes?

_____(1)

d. One academic paper stated that genes coding for defensin were "mobilised into *Agrobacterium tumefaciens*" before being inserted into peanuts. Describe how this might have been done.

_____

_____

_____(3)

Question continues on next page

e. The peanut plants can be described as being transgenic. What are transgenic organisms?

_____

_____(2)

(Total: 10 marks)

7. This question is about meiosis.

a. What is meiosis?

_____

_____(1)

Figure 3 below shows a cell undergoing meiosis.

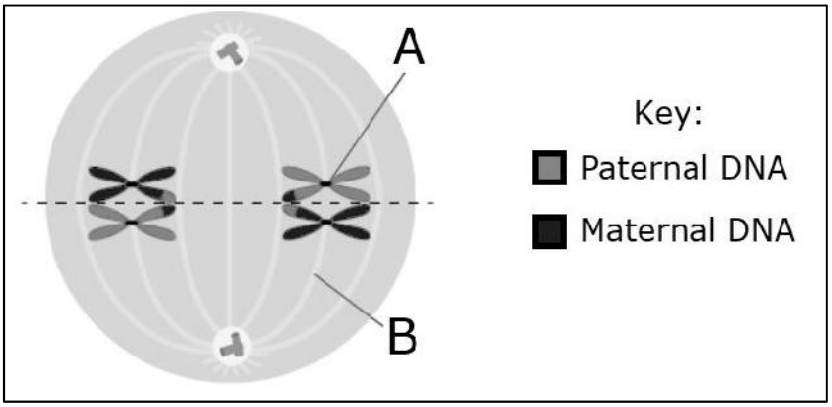

Figure 3: Cell undergoing meiosis
(adapted from https://educatorpages.com/site/MsMars/pages/ap-biology-summer-assignments)

b. Which phase of meiosis is this cell currently in? List **TWO** observations that helped you arrive at your answer.

_____

_____

_____(3)

c. In the following table, name and state the functions of structures A and B (Figure 3):

Structure	Name	Function
A		
B		

(2)

d. Give **TWO** ways by which meiosis result in genetic diversity in eukaryotes.

_____

_____(2)

The graphs in Figure 4 below show the amount of DNA within cells undergoing cell division.

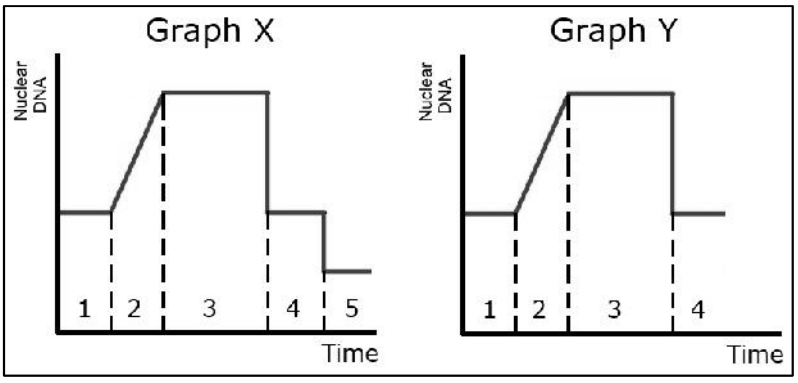

Figure 4: Graphs showing amount of DNA within cells undergoing cell division. The numbers refer to different stages in cell division.
(adapted from https://www.slideshare.net/medik.cz/practical-3-07)

e. Which of the two graphs involves meiosis? Explain.

_____

_____(1)

f. Account for the increase in Nuclear DNA happening in stage 2.

_____

_____(1)

(Total: 10 marks)

Questions continue on next page

8. This question is about transport in animals.

The following image depicts two circulatory systems.

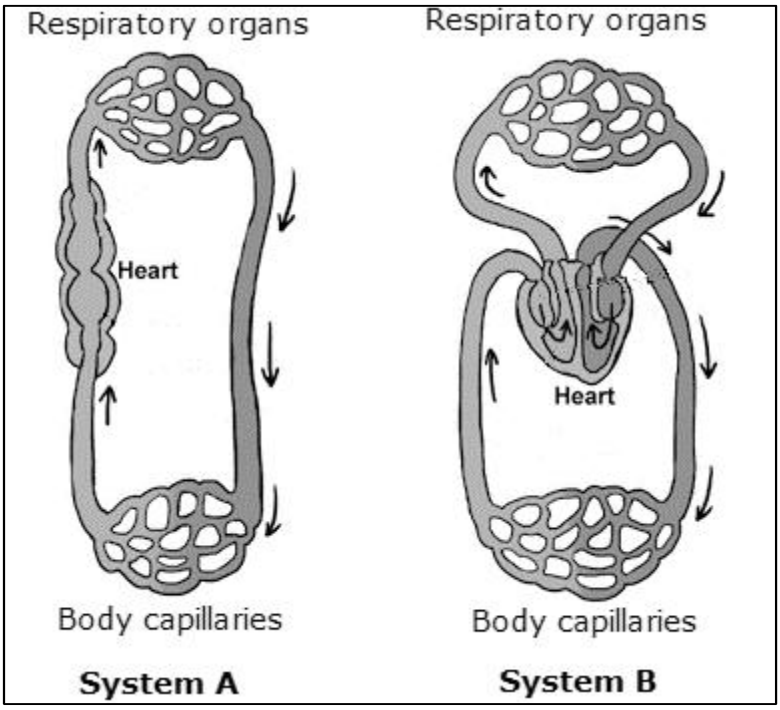

Figure 5: Two different circulatory systems.
(Source: http://userscontent2.emaze.com)

a. How are the two systems similar?

_____(1)

b. How are the two systems different?

_____(1)

c. Give an example of an organism that is characterised by System A and an example of an organism that is characterised by System B.

System A. _____(½)

System B. _____(½)

d. Provide **TWO** advantages of System B over System A.

_____

_____

_____

_____(2)

e. Figure 6 is showing the human heart.

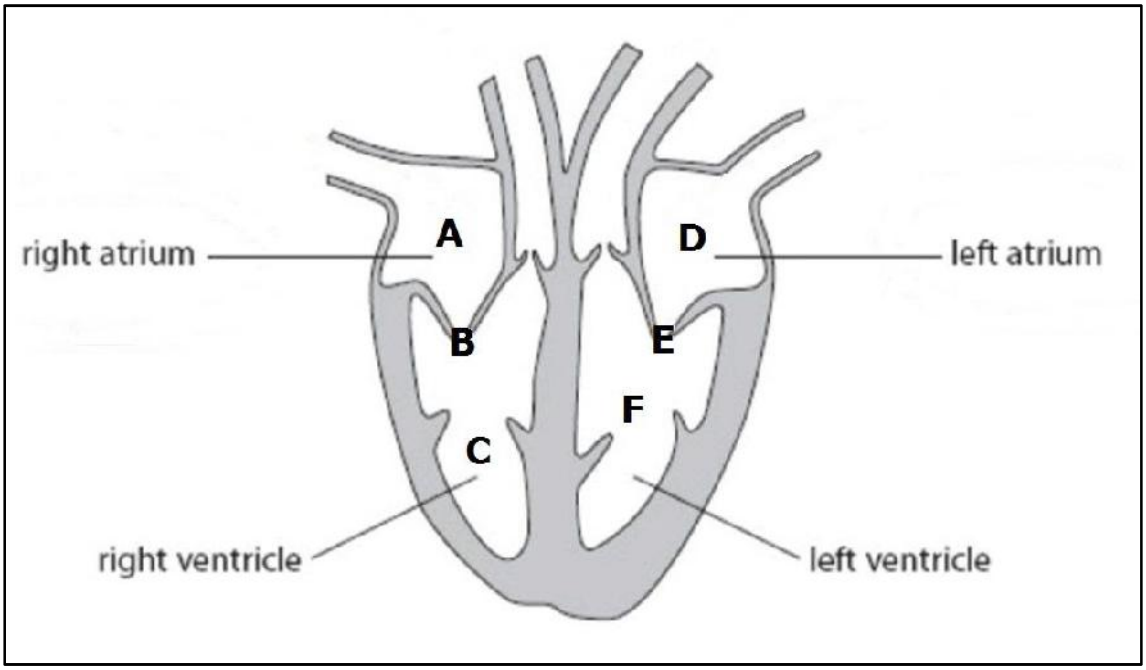

Figure 6: The human heart.
(Source: http://slideplayer.com)

i. On Figure 6, clearly draw arrows to indicate how the blood flows through the heart. (2)

ii. State what is happening during circulation at points A – F.

A. _____

_____

B. _____

_____

C. _____

_____

D. _____

_____

E. _____

_____

F. _____

_____ (6)

(Total: 13 marks)

Questions continue on next page

9. This question concerns interspecific interactions and nitrogen cycle.

The following statements refer to a type of interspecific interactions. Name the type of interspecific interactions being described.

a. *Ardea alba* commonly known as the great egret (a bird species), feeds on insects turned up by grazing mammals or on soil organisms stirred up by ploughing.

Interspecific interaction exhibited: _____ (1)

b. *Viscum album*, commonly known as the mistletoe, infests various species of trees by inserting the haustoria (projections from the root) into the tree's phloem.

Interspecific interaction exhibited: _____ (1)

c. Nitrogen-fixing bacteria living in root nodules of specific plant species change nitrogen gases from the atmosphere into nitrogen compounds that plants can use.

Interspecific interaction exhibited: _____ (1)

d. Question 9(d) refers to nitrogen fixation, which is an important process in the nitrogen cycle.

i. Which enzyme do nitrogen-fixers use to separate the two nitrogen atoms?

_____(1)

ii. Give **TWO** examples of nitrogen-fixing bacteria (the Genus name is sufficient).

_____

_____(2)

iii. Give **TWO** examples of plants that have such a relationship with nitrogen-fixing bacteria.

_____

_____(2)

iv. Define denitrification and highlight any conditions that must be present for this to occur.

(3)

v. Give the scientific name of an organism that carries out denitrification.

(1)

(Total: 12 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2018 FIRST SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	II
DATE:	9th May 2018
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.

SECTION A
This section is obligatory

1. Read carefully the following extract. Then 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.

Australia's A$60 million plan for Great Barrier Reef won't work

The variety of life along the Great Barrier Reef's vast expanse is immense. The Reef's extraordinary biodiversity and the interconnectedness of species and habitats make the Great Barrier Reef and surrounding areas one of the most complex natural systems on Earth. Maintaining a healthy and diverse Great Barrier Reef ecosystem is important so it is better able to withstand, recover and adapt to impacts and stress.

The Australian government's new plan to save the Great Barrier Reef won't work, say environmental groups. Recently, the government pledged an extra A$60 million in funding to protect the natural icon. Most of the funding will go towards removing crown-of-thorns starfish, which eat coral (animals belonging to the Phylum Cnidaria), and preventing farm runoff from entering the reef.

Indeed, these are major threats to the Great Barrier Reef. Crown-of-thorns starfish were responsible for almost half the coral lost between 1985 and 2012. A study carried out in 1986 by Moran, a scientist at the Australian Institute of Marine Science, indicated that the crown-of-thorns starfish has shown the propensity to outbreak in a "boom then bust" fashion on many coral reefs. Reefs which experienced an outbreak showed moderate to high coral mortality in over at least a third of their perimeters. Another major threat was identified to be sludge washing off farms which has also been shown to smother coral and other marine organisms.

However, the most significant damage in recent years has been caused by extreme heat. Coral bleaching during the ferocious summers of 2016 and 2017 left two-thirds of the reef badly degraded. A report published in December concluded that human-induced climate change was the most likely culprit as corals die out when it is too hot or the waters become too acidic.

As a result, environmentalists say the plan ignores the biggest threat to the reef: climate change. According to the Australian Marine Conservation Society, it will be "a classic case of rearranging the deck chairs on the Titanic, unless the federal government moves quickly away from coal and other fossil fuels."

Despite this threat, Australia has the second lowest uptake of renewable energy among high-income OECD countries, according to the World Bank. The government continues to support coal projects, including the planned construction of Australia's largest coal mine just 300 kilometres from the Great Barrier Reef.

(Adapted from https://www.newscientist.com/article/2159303-australias-a60-million-plan-for-great-barrier-reef-wont-work/)

a. Define the term biodiversity (line 2) and name the **THREE** levels in which it must be expressed. (4)

b. Give the phylum and class of the crown-of-thorns starfish. (2)

c. Give **ONE** diagnostic feature of the phylum given as an answer to part (b). (1)

d. Give **TWO** characteristics of the Phylum Cnidaria (line 9). (2)

e. Name and explain the type of population growth exhibited by these predatory starfish. (3)

f. Is the growth given as an answer to part (e), a density-independent or a density-dependent growth? Give a reason for your answer. (2)

g. Give a sketch of the growth curve exhibited by the crown-of-thorns. (3)

h. Which one is the other type of growth curve? Give **ONE** difference between the two basic growth curves. (3)

i. In the extract above, it is explained that the crown-of-thorns starfish is responsible for the disappearance of a lot of corals. Propose a possible environmentally-friendly way of reducing the numbers of these starfish. (2)

j. Briefly discuss why it is essential that "the federal government moves quickly away from coal and other fossil fuels" (lines 24-25) as a measure to mitigate the degradation of the Great Barrier Reef. (3)

(Total: 25 marks)

SECTION B

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

1. Each second the cells in our body manufacture hundreds of different proteins. Give a detailed, illustrated account of how the information encoded in the sequence of nucleotides in DNA is used to produce a sequence of amino acids in a protein.

2. Fick's law of diffusion explains how different organisms are adapted for gas exchange. Discuss this statement by comparing gaseous exchange in insects, bony fish and mammals.

3. Homeostasis is a word that does not imply something set and immobile, it means conditions which may vary, but which are relatively constant. Discuss with reference to control systems and feedback mechanisms.

4. Give a detailed, illustrated account of the events taking place during fertilisation of an angiosperm.

(Total: 50 marks)

Questions continue on next page

SECTION C
Answer ONE question from this section.

1. Use your knowledge of Biology to distinguish between the following pairs:
   a. diploblastic and triploblastic organisms; (5)
   b. oogenesis and spermatogenesis; (5)
   c. codominance and incomplete dominance; (5)
   d. aneuploidy and polyploidy; (5)
   e. sino-atrial node and atrioventricular node. (5)

OR

2. Use your knowledge of Biology to explain the following statements.
   a. Following a zombie apocalypse, during which the human population was infected by a deadly virus, only a few individuals survived. Genetic variation will be reduced in the next generation. (5)

   b. *Egeria* sp. is able to survive as a fully submerged hydrophyte. (5)

   c. Darwin's finches (birds) inhabiting the Galapagos Islands exhibit differences in beak shape and size so they could eat different food and occupy different ecological niches. Those at the extremes of the population did not suffer so much from intraspecific competition and so survived and reproduce more than the medium-range beaks. (5)

   d. The corpus luteum is universally thought of as a temporary endocrine structure. (5)

   e. Elephant populations were trapped on the Maltese Islands during the Pleistocene period (geological time) and gradually developed into dwarf forms that were different from the parent population. (5)

(Total: 25 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2018 FIRST SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	III
DATE:	10th May 2018
TIME:	4:00 p.m. to 5:35 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	**Total**
Score				
Maximum	19	11	20	**50**

1. This question is about Enzymes.

Hydrogen peroxide (H_2O_2) is naturally produced in many organisms as a by-product of metabolism. H_2O_2 is toxic especially if in high concentrations. Most organisms are capable of enzymatically destroying this by-product before it can do much damage. H_2O_2 is converted to water and oxygen as per chemical equation below:

$$2H_2O_2 \xrightarrow{\text{Catalase}} 2H_2O + O_2$$

Hydrogen peroxide — Water — Oxygen

Although this reaction occurs spontaneously, enzymes increase the rate considerably. Catalase is a common enzyme found in nearly all living organisms, and it is used to catalyse the decomposition of H_2O_2. Catalase is not consumed during this reaction and it works the most efficiently at pH 6.8.

An experiment was carried out to analyse the effect of multiple factors on the rate at which catalase breaks down H_20_2. Chicken liver and potato were used as sources of catalase. The apparatus was set as shown in Figure 1.

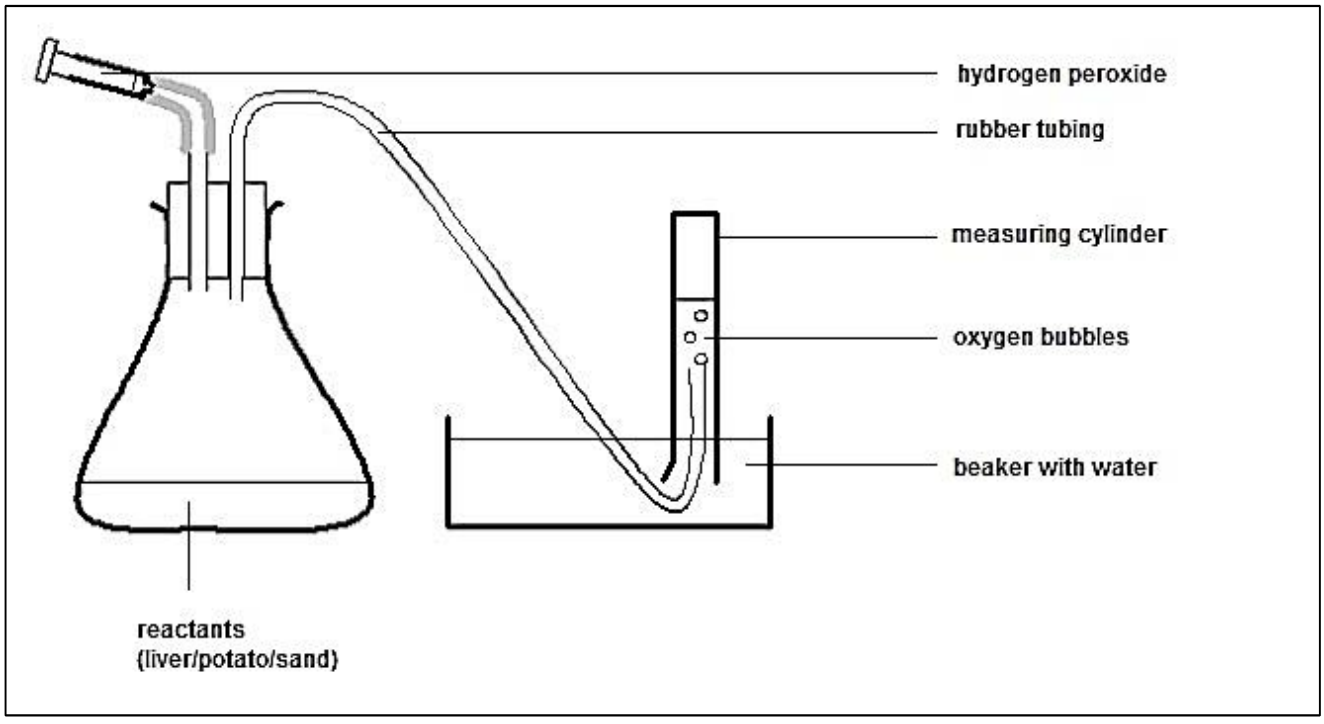


Figure 1: Factors affecting the activity of Catalase – Experiment Set-up
(Source:http://www.nuffieldfoundation.org/sites/default/files/PB_investigating-an-enzyme-controlled-reaction-catalase-and-hydrogen-peroxide-concentration.jpg)

Reagents were poured or placed into the conical flask and the flask was sealed with a rubber bung. A syringe was used to introduce the H_2O_2 in an air-tight system. Once the syringe plunger was pushed, the stopwatch was started and after 60 seconds, the volume

of oxygen in the measuring cylinder was noted. The apparatus was then dismantled and rinsed, and the experiment was repeated for the different reactions described in Table 1.

Table 1: Factors affecting the activity of catalase – Experiment results

Reaction		**Volume of O_2 generated after 60s / cm^3**
Part A		
1.	1 cm^3 sand + 2 mL H_2O_2	0
2.	1 cm^3 liver strips + 2 mL H_2O_2	10
3.	1 cm^3 potato strips + 2 mL H_2O_2	6
Part B		
1.	1 cm^3 used liver strips + 1 cm^3 fresh liver strips	0
2.	1 cm^3 used liver strips + 2 mL H_2O_2	6
Part C		
1.	1 cm^3 crushed liver + 2 mL H_2O_2	13
2.	1 cm^3 crushed potato + 2 mL H_2O_2	10
Part D		
1.	1 cm^3 boiled liver strips + 2 mL H_2O_2	0
2.	1 cm^3 liver strips at 37°C + 2 mL H_2O_2	14
3.	1 cm^3 liver strips at 0°C + 2 mL H_2O_2	4
Part E		
1.	0.5 cm^3 of liver + 2 mL H_2O_2	4.5
2.	1 cm^3 of liver + 2 mL H_2O_2	10
3.	2 cm^3 of liver + 2 mL H_2O_2	18
4.	4 cm^3 of liver + 2 mL H_2O_2	21
5.	8 cm^3 of liver + 2 mL H_2O_2	22

Question continues on next page

a. Reactions in Part A of this experiment consisted of mixing hydrogen peroxide with equal volumes of sand, liver strips and potato strips respectively. Describe the observations you would have expected and explain the results of each of these three reactions in terms of catalase activity.

(3)

b. Which of the three reactions in Part A can be used as a control? Explain.

(1)

c. How would the experiment results change, provided that there is a change, if three drops of vinegar (5% acetic acid) were added to each of the three reactions in Part A of this experiment? Give reasons for your answer.

(2)

d. In Part B of this experiment, fresh liver strips were added to liver strips already used to catalyse the H_20_2 that was present in the reaction. Explain why no oxygen was given off in this reaction.

(1)

e. Different results were observed when more H_20_2 was added to used liver strips. Describe and explain the results observed for this reaction.

_____

_____

_____

_____ (2)

f. Describe what happened when liver and potato were used in crushed form rather than in strips. Explain why crushing these reagents gave different results than those observed in Part A of this experiment.

_____

_____

_____

_____

_____

_____ (3)

g. Interpret the results obtained in Part D of this experiment in terms of the effect of temperature on catalase activity.

_____

_____

_____

_____

_____

_____

_____(3)

Question continues on next page

h. The aim of Part E of this experiment was to study the effect of varying the volume of liver (i.e. catalase concentration) used in the reaction, on the rate of H_20_2 decomposition. Explain the results obtained for the different increments of liver volume used in the reaction.

(4)

(Total: 19 marks)

2. This question is about **Taxonomy.**

a. The organisms in Figures 2 and 3 in the table below belong to the Phylum Arthropoda.

		 Figure 2 *(Source: http://3.bp.blogspot.com/-_Je5wJgI934/UQFzFEYarRI/AAAAAAAAAn8/Q39bRBXLaq4/s1600/)*	 Figure 3 *(Source: https://farm7.staticflickr.com/6084/6083691629_194399f7bf_o.jpg)*
i.	Which class do these organisms belong to?		
ii.	Identify the tagmata.		
iii.	Mention **ONE** visible characteristic features for each organism.		

(6)

Question continues on next page.

b. i. Which major group within the plant kingdom does the species in Figure 4 belong to?

_____ (1)

Figure 4
(Source: https://upload.wikimedia.org/wikipedia/commons/thumb/3/33/)

ii. Identify structure X.

_____(1)

c. i. Name **TWO** taxonimic ranks (e.g. division and class) within the Plant Kingdom for the species shown in Figure 5.

_____

_____

(2)

Figure 5
(Source: https://upload.wikimedia.org/wikipedia/commons/thumb/7/71/)

ii. This species is homosporous. Explain.

_____

_____

_____ (1)

(Total: 11 marks)

3. This question is about Plant Structure and Support Tissue.

Figure 6 shows a transverse section across a dicot root.

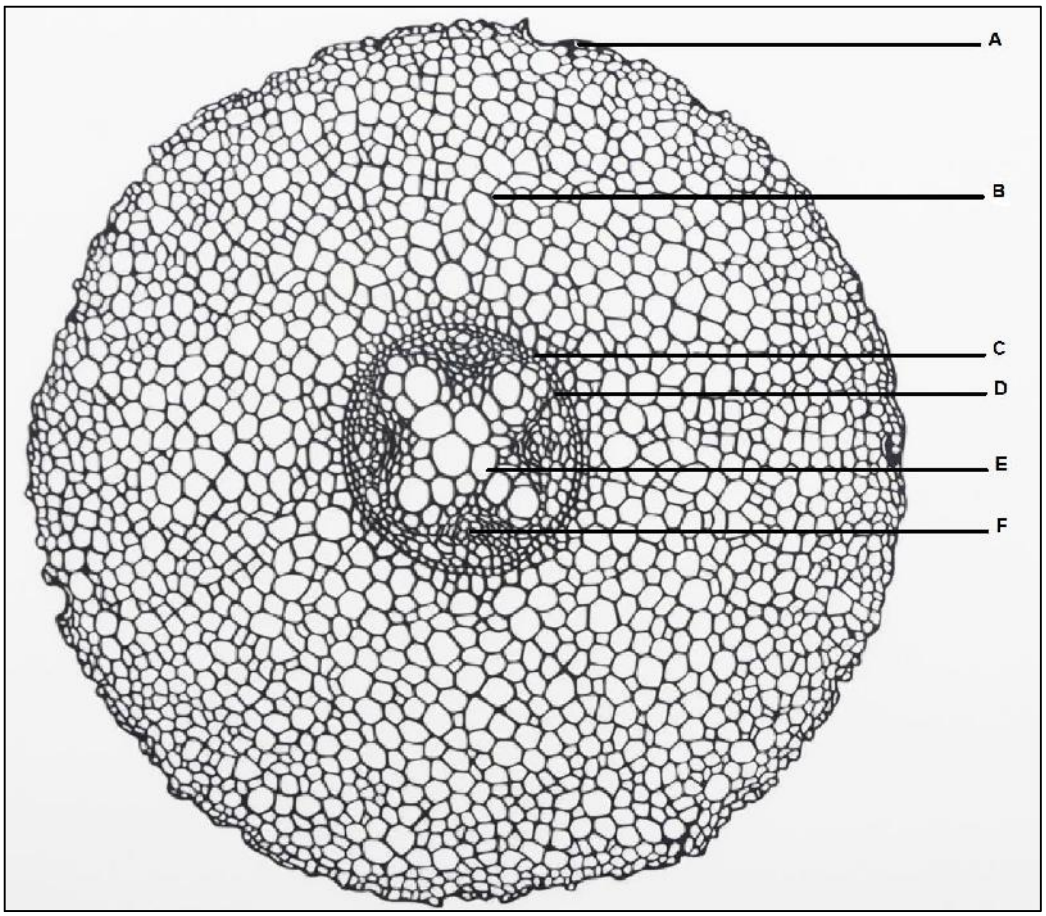


Figure 6: A T.S through a dicot root
(Source: https://cdn.incollect.com/sites/default/files/zoom/Quatro-Series-Dicot-Root-217886-462962.jpg)

a. Identify the root structures labelled A to F and list the main plant tissue making up each structure.

Label	Structure	Tissue
A		
B		
C		
D		
E		
F		

(6)

Question continues on next page

b. Figure 7 shows a transverse section through a monocot root.

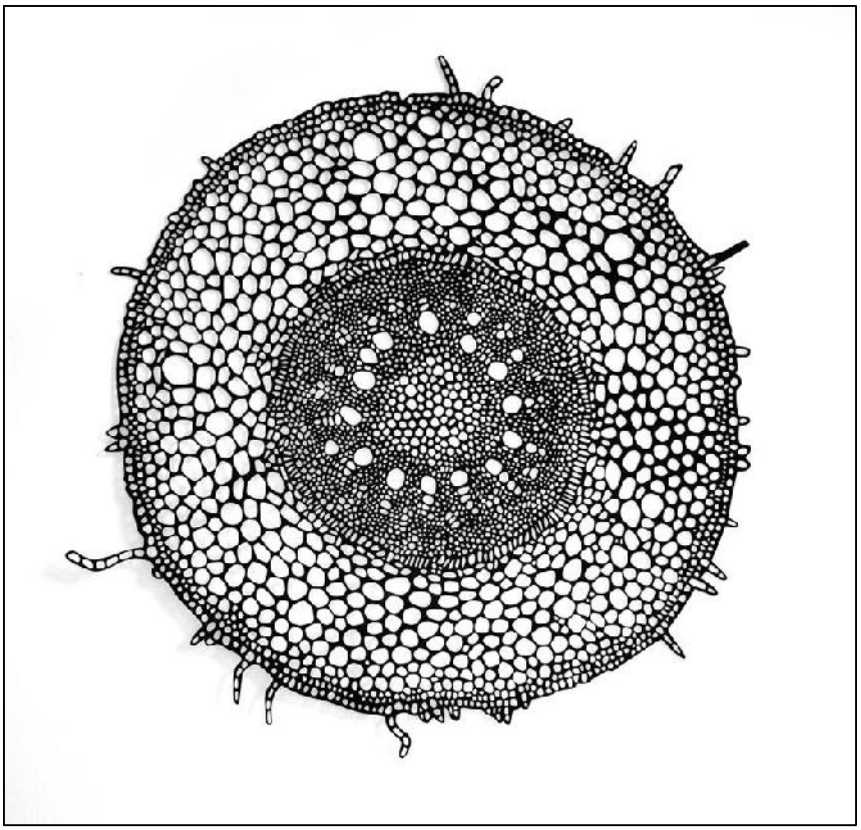


Figure 7: TS through monocot root
(Source: https://iliad.nyc/product/monocot-root-2009/)

Describe **TWO** ways in which the monocot root shown in Figure 7 would be different from the dicot root shown in Figure 6.

_____

_____

_____

_____(2)

c. Figure 8 shows a longitudinal section through xylem cells as seen under the microscope.

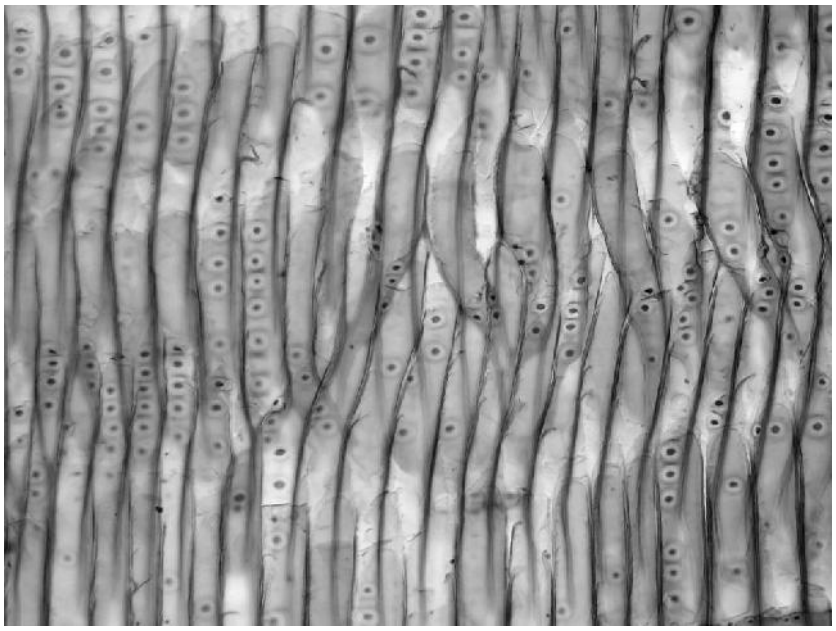


Figure 8: A L.S through xylem cells
(Source: https://c1.staticflickr.com/7/6167/6214945857_726890a713_b.jpg)

i. Which xylem cells are these?

_____ (1)

ii. Mention **TWO** visible features that are characteristic to these xylem cells.

_____

_____ (2)

iii. Explain how the structure of the xylem relates to its mechanical support function.

_____

_____

_____(1)

d. Figure 9, overleaf, shows a section of a herbaceous stem as seen under the microscope.

Question continues on next page

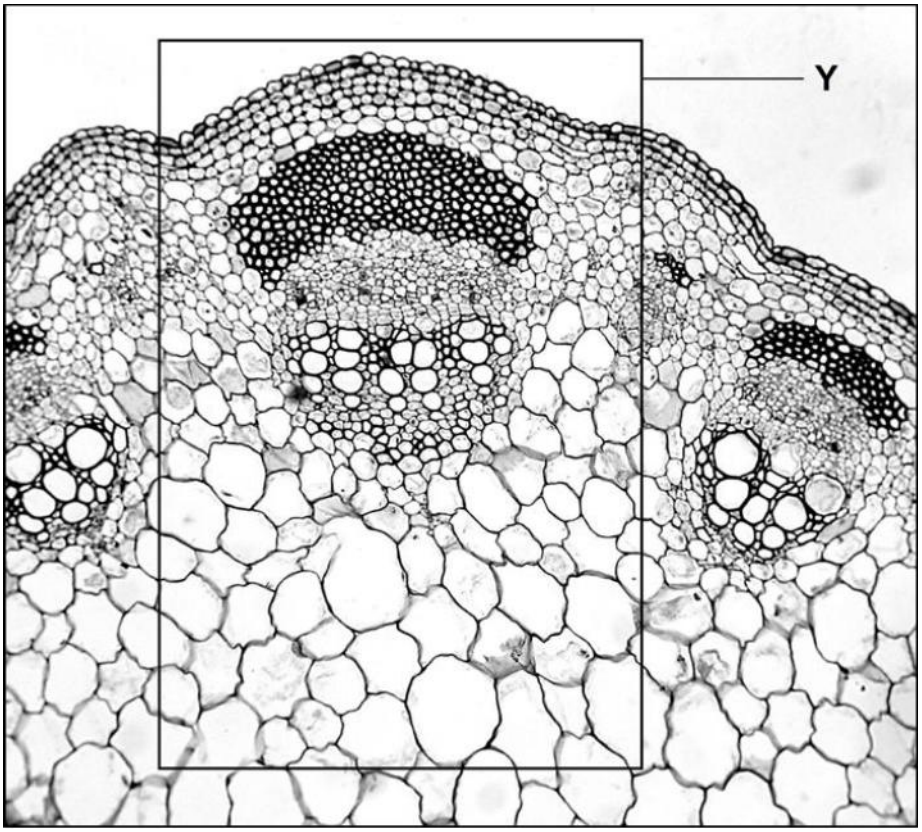


Figure 9: T.S through a herbaceous stem
(Source: http://www.thealevelbiologist.co.uk/)

In the space below, draw and label the section of the stem marked as Y. Give **FIVE** labels to indicate the respective ground and vascular tissue cells.

(8)

(Total: 20 marks)

Index No.:_____ AM 05/IV.18m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2018 FIRST SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IV – *Practical*
DATE:	6th June 2018
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

1. Research has shown that effective sports drinks should contain around 6 – 8 % carbohydrates. Glucose is a carbohydrate which is commonly found in such drinks.

   Glucose ($C_6H_{12}O_6$) is a monosaccharide reducing sugar. Glucose reacts with potassium permanganate and the purple pink solution of potassium permanganate (MnO_4^-) is reduced to a colourless solution of manganese ions (Mn^{2+}). As a result of this reaction, the glucose is oxidised. The time taken for the loss of colour from a standardised solution of permanganate is directly related to the concentration of glucose present in solution.

   You are required to devise and implement an experimental procedure to find levels of glucose in **THREE** different solutions.

   You are provided with the following material:
   - glucose solutions (2%, 4%, 6%, 8%, 10%);
   - three solutions of unknown glucose concentration (A, B, C);
   - sulfuric acid;
   - potassium permanganate;
   - other laboratory apparatus as required.

   Candidates are advised to use the following volumes:
   - **Glucose solutions: 5 cm^3;**
   - **Sulfuric acid: 2.5 cm^3;**
   - **Potassium permanganate: 1 cm^3.**

   a. State the aim of your biological investigation.

   _____

   _____

   _____ (1)

   b. Using the material provided, devise and describe an experimental procedure that may be used in order to determine the concentration of glucose in the solutions provided.

   _____

   _____

   _____

   _____

   _____

   _____

   _____

(10)

c. List and justify **TWO** precautions that should be taken before the start of the experiment.

(4)

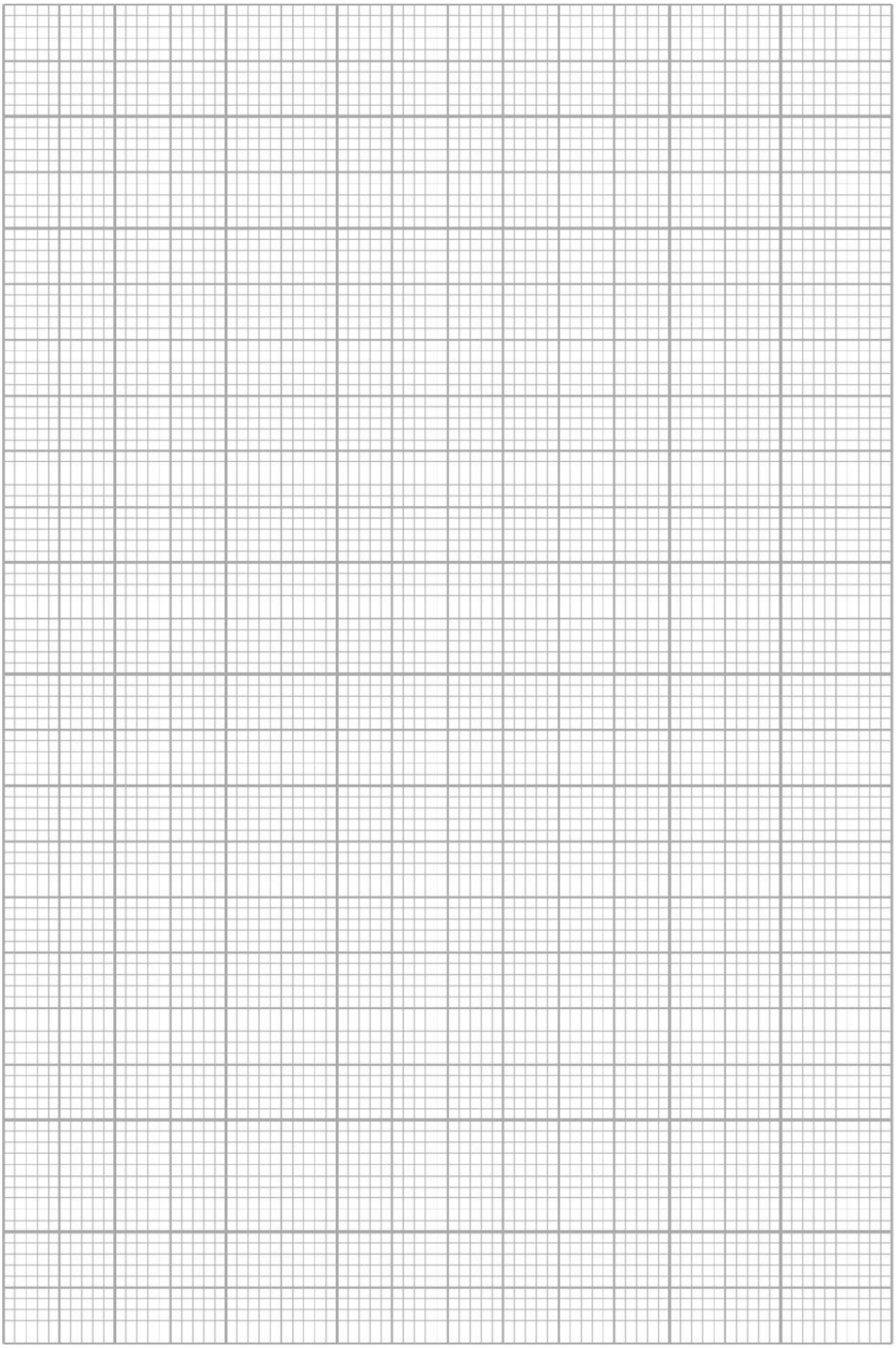
Carry out the investigation that you devised and record the results in part (d) overleaf.

Question continues on next page.

d. Record your raw data in the space provided below. (Marks will be awarded for the structure and the organisation of the results obtained.)

(4)

e. Use the graph paper below to draw a calibration graph (6)



f. Interpret the calibration graph drawn in part (e).

(2)

g. Use the calibration graph to determine the concentration of glucose in solutions A, B and C.

(6)

h. From the results obtained in part (g), deduce which solution, from A, B and C, is ideal to use in the preparation of a sports drink. (Assume that glucose is the only source of carbohydrate used in the preparation).

(2)

i. How would this solution help an athlete achieve better performance?

(2)

j. List **TWO** possible sources of error in your investigation.

_____

_____

_____

_____(2)

k. Briefly describe **ONE** modification you would do to your experimental set-up to produce more reliable results.

_____

_____

_____

_____ (1)

(Total: 40 marks)

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