Index No.:_____ AM 05/I.19m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2019 FIRST SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	I
DATE:	6th May 2019
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	10	11	**Total**
Score												
Maximum	8	7	11	6	11	11	6	10	10	12	8	**100**

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1. This question is about biodiversity.

   Species diversity is defined as the number of species and abundance of each species that live in a particular location.

   a. Apart from species diversity, biological diversity is also expressed on another two levels. Name them.

      _____ diversity and _____ diversity. (1)

   b. While studying the species diversity of an area, a scientist counted the following:
      - five species of mice;
      - two species of squirrels and
      - one species of weasel.

      i. Name the phylum to which all these organisms belong.

      _____ (1)

      ii. List **TWO** diagnostic characteristics of this phylum.

      _____

      _____ (2)

      iii. The scientist also found some organisms that laid cleidoic eggs. What are cleidoic eggs and what is their evolutionary significance?

      _____

      _____

      _____

      _____ (3)

      iv. During this study, the scientist encountered an unidentified organism. The organism exhibited bilateral symmetry and showed a degree of cephalisation. Further studies revealed that it was triploblastic and acoelomate. To which phylum does it belong?

      _____ (1)

(Total: 8 marks)

2. This question is about transport across membranes.

In the kidney, glucose is transported with sodium ions into the proximal convoluted tubule walls via a symporter which is a type of cotransporter.

a. The movement described above is an example of secondary active transport. Distinguish between primary and secondary active transport.

_____

_____

_____

_____ (2)

b. Another well-known cotransporter involving sodium ions is an antiporter that works with primary active transport and uses another ion. Using all the information given, continue Figure 1 below by adding an arrow on each of the two cotransporters and indicate which chemical flows along the drawn arrows:

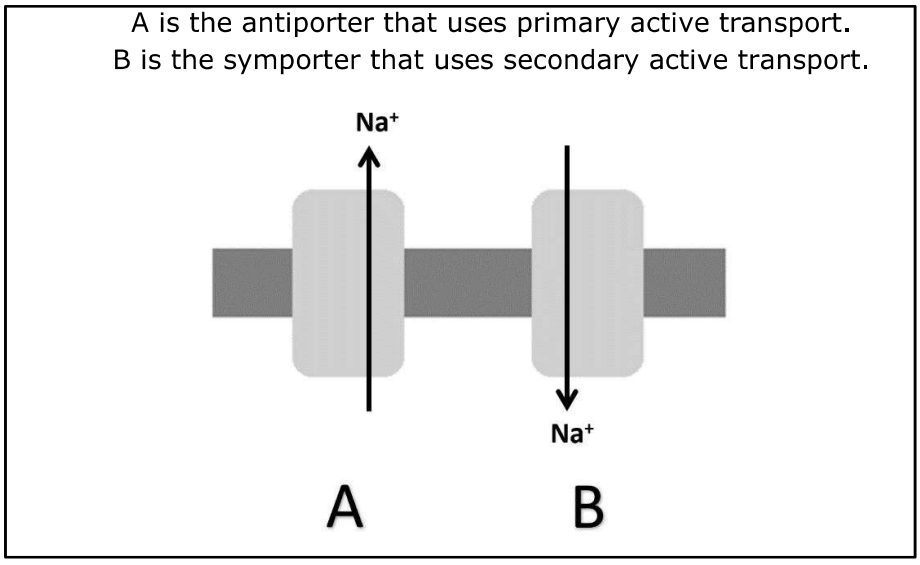

Figure 1: Figure showing two cotransporter systems, an antiporter (A) and a symporter (B) (3)

c. Once inside the tubule wall, glucose is then transported into the blood capillaries via GLUT2 transporters along its concentration gradient. What kind of transport is this?

_____ (1)

d. Points X and Y are two points in a kidney. The water potential in point X was found to be -450 MPa whereas that in point Y was found to be -300 MPa. Fill in the blanks of the following statement:

Water travels from point _____ to point _____ by osmosis. (1)

(Total: 7 marks)

3. This question is about protein synthesis.

Figure 2 below shows a strand of mRNA attached to a group of ribosomes.

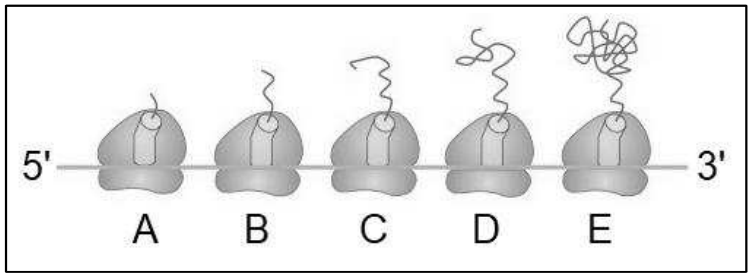

Figure 2: Group of ribosomes on an mRNA strand.
(Adapted from: http://ib.bioninja.com.au/higher-level/topic-7-nucleic-acids/)

a. Name the process that is happening on the ribosomes.

_____ (1)

b. What is the name given to this assemblage consisting of a thread of mRNA with its ribosomes and their growing polypeptide chains?

_____ (1)

c. Explain why the polypeptide chain on ribosome E is much longer than that on A.

_____

_____ (2)

d. Figure 3 shows in detail the process happening on ribosome A.

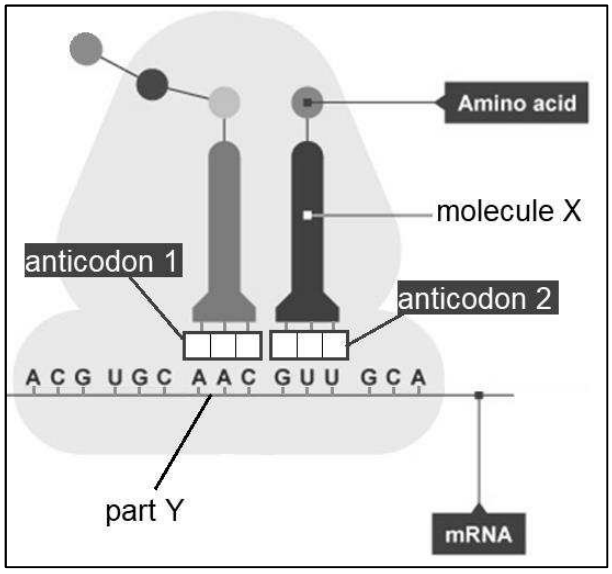

Figure 3: Formation of an amino acid chain.
(Adapted from: http://www.bbc.co.uk)

i. What is the name of molecule X?

_____ (1)

ii. Which **TWO** components can be found in part Y?

_____ (2)

iii. What are anticodons?

_____ (1)

iv. Give the base sequence of anticodon 1 and anticodon 2 taken from Figure 3.

	Anticodon 1				Anticodon 2		
mRNA	A	A	C		G	U	U

(1)

e. When the mRNA shown in Figure 2 was compared to the DNA that acted as a template for its production, the mRNA was found to be much shorter than the DNA. Explain.

_____

_____

_____ (2)

(Total: 11 marks)

4. This question is about mutations.

Essential genes are those genes of an organism that are thought to be critical for its survival. Mutations to these genes are often lethal to the organism due to the production of important proteins with abnormal tertiary structures.

a. Explain how a gene mutation in the DNA could lead to a change in the tertiary structure of a protein.

_____

_____

_____ (2)

b. In one study, scientists isolated a particular essential gene from a colony of bacteria. They examined the genes for mutations. The results are shown in Table 1.

Table 1: Percentage of genes containing mutations

Type of mutation	Percentage of genes containing mutations
Substitution	3.9%
Insertion	0.1%
Deletion	0.2%

i. Insertions and deletions often lead to frameshift mutations. Explain.

_____

_____ (2)

ii. Account for the higher frequency of substitution mutations observed in the results.

_____

_____

_____ (2)

(Total: 6 marks)

5. This question is about skeletal systems and support.

The human endoskeleton is made up of bones. Bones have a complex internal and external structure which varies between the type and location of the bone.

a. The Haversian canal and the osteocytes found in bones are responsible for the viability and structure integrity of bones. Explain.

_____

_____

_____

_____

_____

_____ (4)

b. Osteoporosis is a condition in which there is a loss of the mineral part of the bone and thinning and disintegration of the spongy part of the bone. Why would this lead more easily to fractures?

_____

_____

_____

_____ (2)

c. Other skeletal systems are found in the animal kingdom. Name another skeletal system (apart from an endoskeleton) and give **ONE** example of an animal that possesses it.

_____

_____ (2)

d. Name **THREE** supporting tissues in plants and briefly describe how each is adapted to provide support.

i. _____

_____ (1)

ii. _____

_____ (1)

iii. _____

_____ (1)

(Total: 11 marks)

Questions continue on next page

6. This question is about biotechnology.

In the 20th century, diabetics or insulin-resistant patients were given daily injections of insulin obtained from the pancreas of slaughtered cattle. On the other hand, the growth hormone, for patients suffering from dwarfism, was procured from the pituitary gland of corpses.

a. Deduce **ONE** problem encountered when the insulin or the human growth hormone were extracted from slaughtered cattle or corpses.

_____ (2)

b. Modern society supplies missing hormones by using genetically engineered bacteria. List **TWO** advantages of using such an approach.

_____

_____ (2)

c. The end product which is the genetically engineered bacteria is made using four basic tools: restriction enzymes; vectors, DNA ligase and a host.

i. Why do bacteria naturally produce restriction enzymes?

_____

_____ (1)

ii. Mention **TWO** common vectors used in genetically engineered bacteria.

_____

_____ (2)

iii. What is the role of DNA ligase?

_____

_____ (2)

iv. List **ONE** way by which foreign DNA may be inserted into host cells.

_____ (1)

d. Briefly explain why the polymerase chain reaction is often used in biotechnology.

_____ (1)

(Total: 11 marks)

7. This question is about the neuromuscular junction.

Movement of the limbs within microseconds of thinking about such a movement is a result of the nervous system evolving along with the musculo-skeletal system.

a. Define the neuromuscular junction.

(2)

b. Briefly describe the sequence of events that allow an action potential arriving at an axon terminal to be transferred through a neuromuscular junction.

(4)

(Total: 6 marks)

8. This question is about human reproduction.

a. Briefly explain the process of spermatogenesis.

(6)

b. Figure 4 shows a graph of the female menstrual cycle.

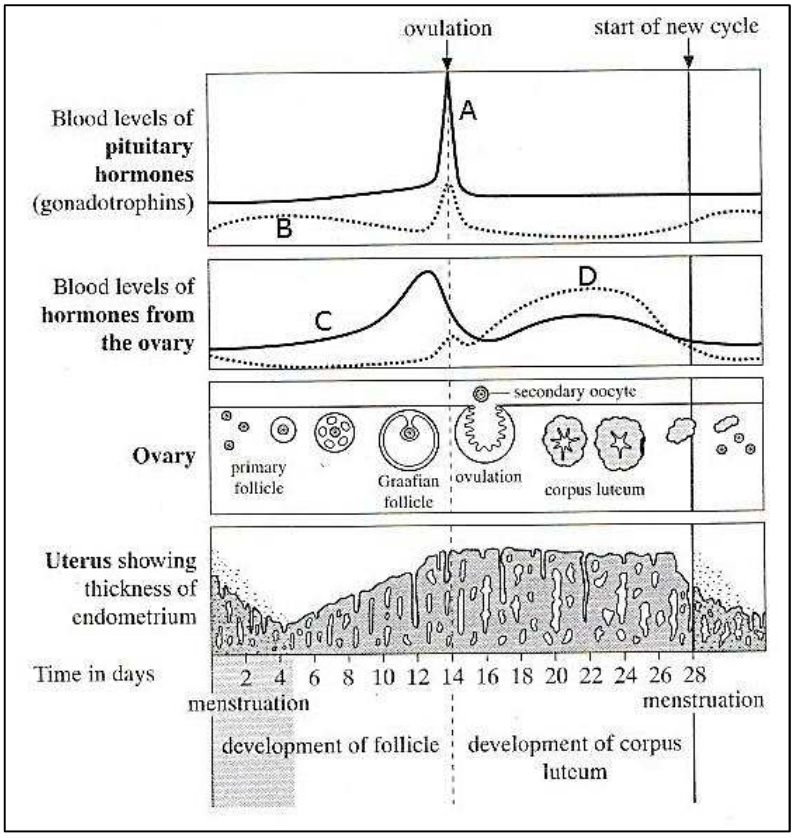

Figure 4: The female menstrual cycle.
(Source: Taylor et al., 2004)

i. Identify the hormones labelled A – D.

A._____

B._____

C._____

D._____ (2)

ii. State the role of the hormones labelled A – D.

A._____

B._____

C._____

D._____ (2)

(Total: 10 marks)

9. This question is about nutrition in plants.

Figure 5 is a diagrammatic representation of a cross-section of a leaf.

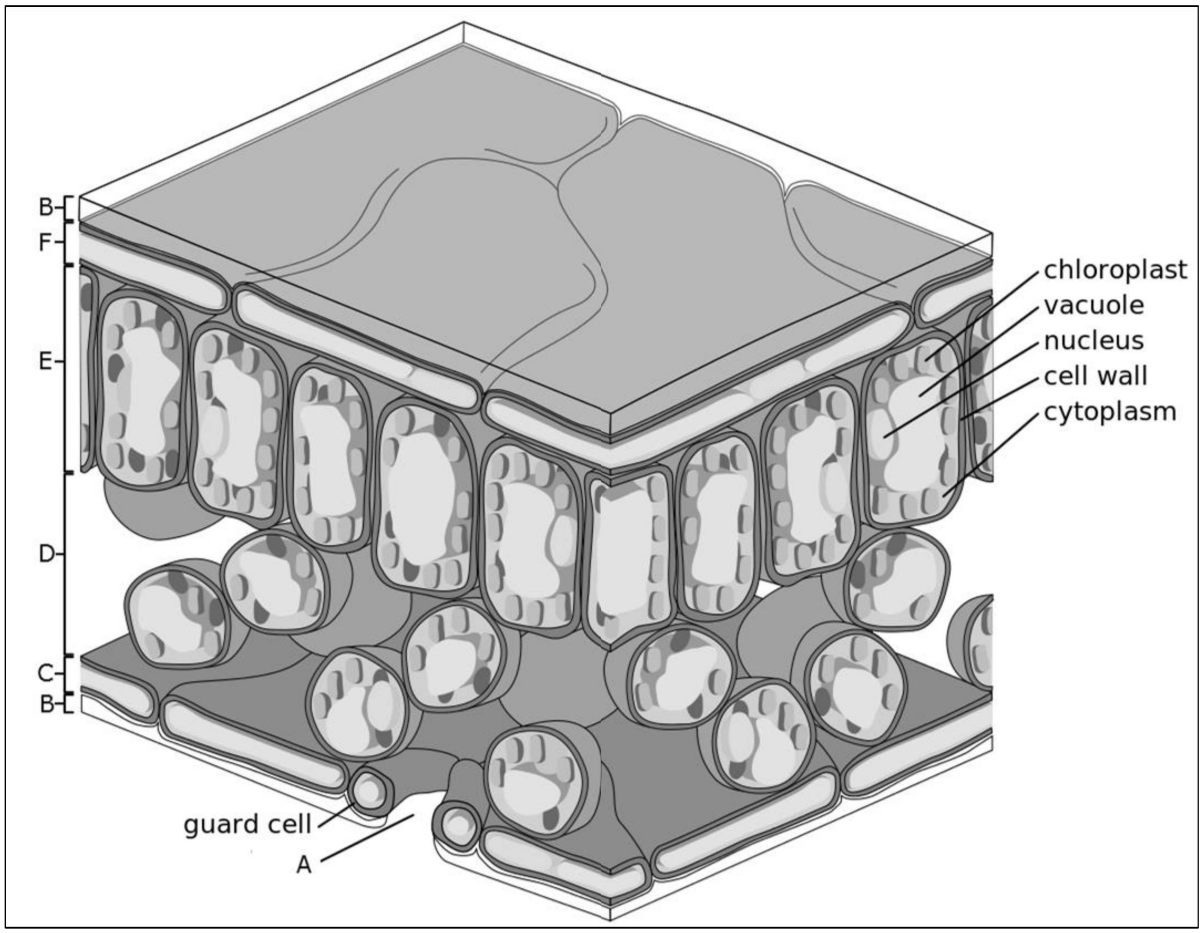

Figure 5: Cross section of a leaf.
(Source: https://www.tes.com)

a. Label the various structures indicated in Figure 5.

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____ (3)

Question continues on next page

b. Figure 6 shows the action spectrum for photosynthesis compared with absorption spectrum of photosynthetic pigments.

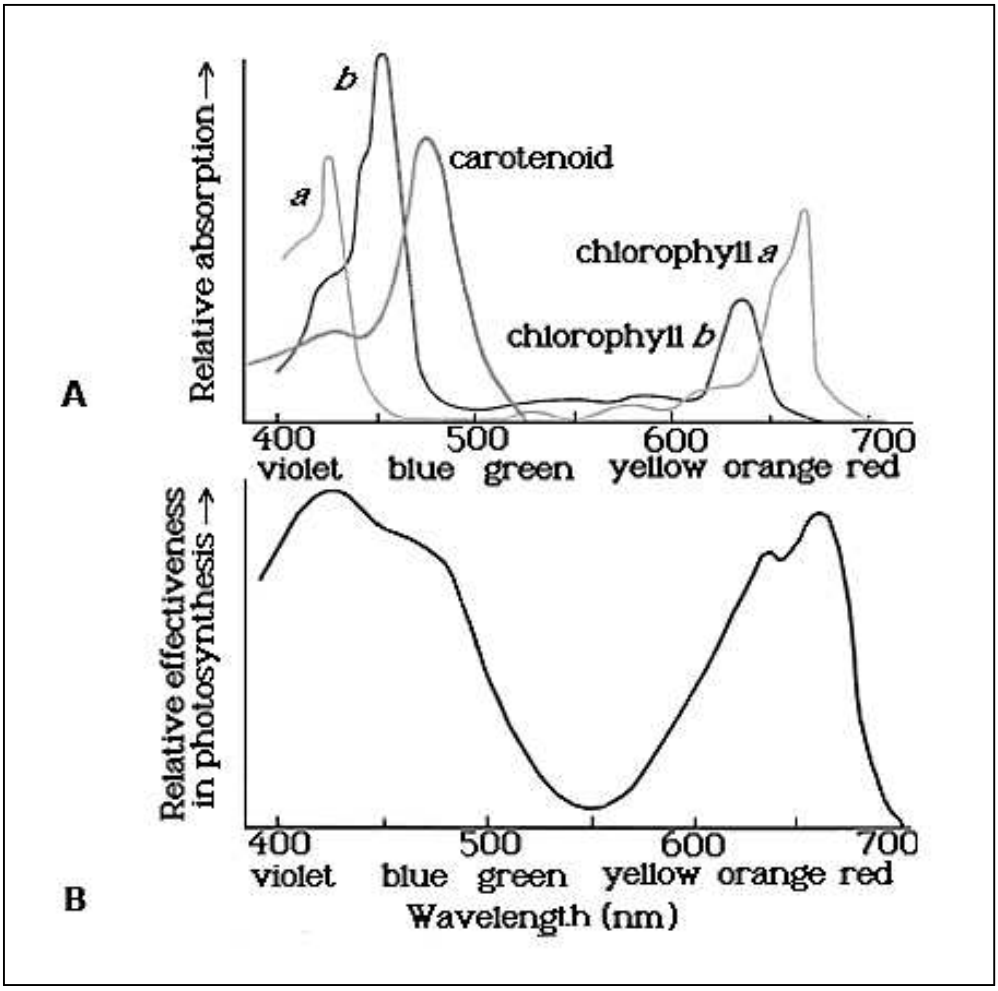

Figure 6: Absorption (A) and action (B) spectra of photosynthetic pigments.
(Source: https://static1.squarespace.com)

i. Distinguish between absorption and action spectra.

(2)

ii. Explain the relationship between the action and absorption spectra of the different pigments depicted in Figure 6.

_____

_____

_____

_____(2)

c. Photosynthesis is characterised by both light-dependent and light-independent reactions. Fill in Table 2 by comparing these two reactions.

Table 2: Comparison of light-dependent and light-independent reactions

	Light-dependent reaction	**Light-independent reaction**
Location in chloroplast		
Reactions involved		
Results		

(3)

(Total: 10 marks)

Questions continue on next page

10. This question is about evolution.

a. Identify and justify the main agent of evolutionary change depicted in the following examples.

i. A parasitic infection attacks a group of angelfish, killing most of the blue ones but leaving most of the orange ones alive, resulting in fewer blue angelfish being produced in the population.

Agent: _____ (1)

Justification: _____ (1)

ii. Green parrots are brought on an expedition to a remote section of the jungle with only grey parrots, introducing colour variation into the gene pool of jungle parrots.

Agent: _____ (1)

Justification: _____ (1)

iii. A particular species of orchid has a type of self-pollination mechanism in which the bisexual flower turns its anther against gravity through 360° in order to insert pollen into its own stigma cavity, without the aid of any pollinating agent or medium.

Agent: _____ (1)

Justification: _____ (1)

iv. Humans with one copy of a different variant of haemoglobin, named HbC are 29% less likely to get malaria, while people with two copies enjoy a 93% reduction in risk.

Agent: _____ (1)

Justification: _____ (1)

b. Identify and explain the **TWO** types of speciation depicted in Figure 7.

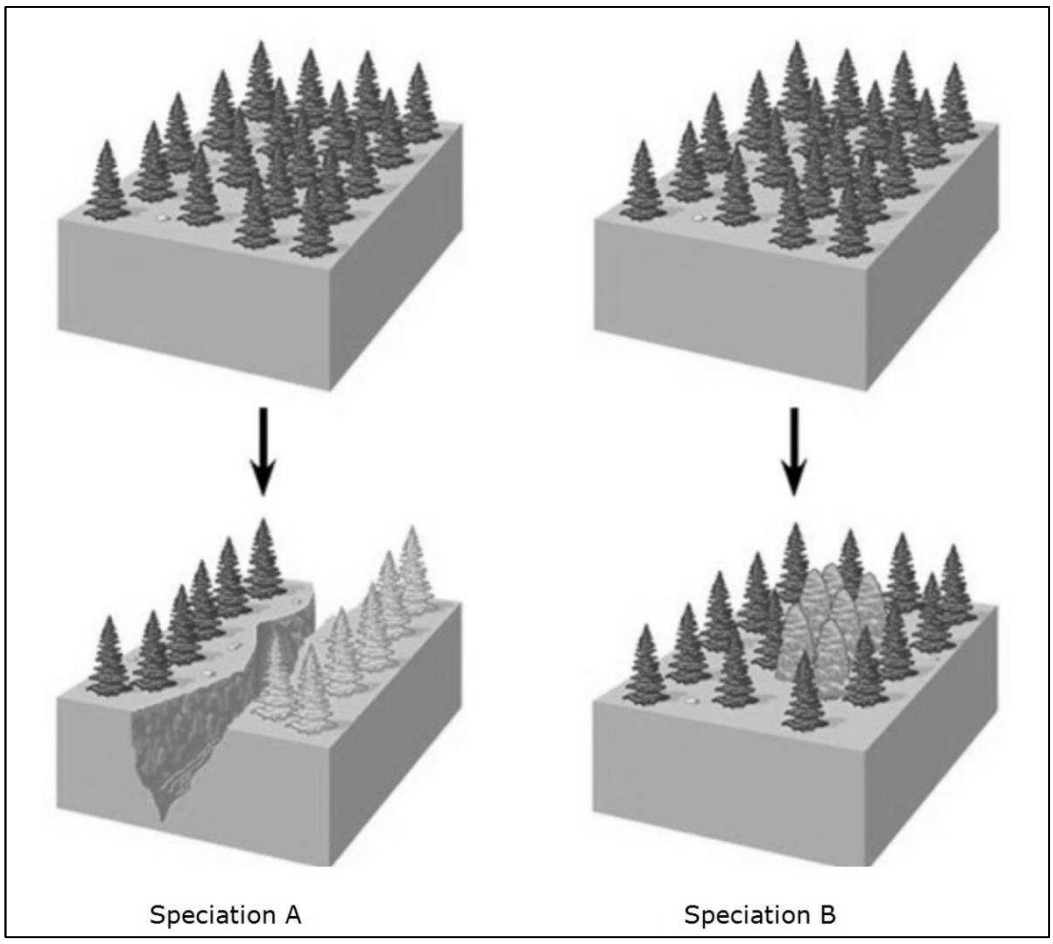

Figure 7: Two types of speciation.
(Source: https://socratic.org)

Speciation A:

Speciation B:

(4)
(Total: 12 marks)

11. This question is about ecological communities.

a. Woodpecker species have different diets, and this can be deducted by looking at their tongues which have different structures. The tongue of one species of woodpecker is piliated and serrated and can snag insects. The tongue of another species is packed with brush-like fibres that mop up tree sap. How does resource partitioning between these two species affect the strength of competition between them?

(2)

b. Resource partitioning may be thought of as a highly specialised mode of coexisting with a closely related organism in a community. Another survival strategy would be that of a generalist.

i. Define the terms, generalists and specialists. Refer to the niche breadth in your answer.

(4)

ii. Give **ONE** advantage of generalist survival strategy.

(1)

iii. Give **ONE** disadvantage of specialists.

(1)

(Total: 8 marks)

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2019 FIRST SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	II
DATE:	8th May 2019
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
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.

Metabolism may be older than life itself: a chicken-egg dilemma

A set of chemical reactions occurring in Earth's early environments could have provided the foundations upon which life evolved. A recent discovery involving Krebs cycle suggests that metabolism is older than life itself. But how did such a complex cycle develop in the first place?

One idea is that it began after RNA came into being since RNA is needed for enzyme production. There is, however, a problem with this "RNA first" hypothesis: if the reactions didn't already occur immediately in early life forms and provide them with a survival advantage, then there wouldn't have been a selective pressure to drive the evolution of enzymes.

Consequently, another hypothesis emerged stating that the cycle existed from the outset and early life adopted it and developed enzymes to make it more efficient. Yet the idea that the simple molecules that existed naturally in early oceans could catalyse such a diverse set of reactions was once dismissed as an "appeal to magic". Now Markus Ralser and his colleagues appear to have pulled a catalyst out of the hat, and no magic wand was necessary.

Ralser previously showed that glycolysis could be catalysed by metal ions present on early Earth rather than enzymes used by cells today. But sceptics of the "metabolism first" hypothesis have argued that the starting material for glycolysis is unlikely to have existed at the time. Moreover, this pathway runs in only one direction, whereas early life would have needed both.

So Ralser has now shifted his focus to the Krebs cycle. The chemicals involved at various points of this cycle have been identified on meteorites and in recreations of Earth's early oceans – so we know they were around. "If we can provide proof that the Krebs cycle could originate from a single, non-enzymatic catalyst, then we would have a very strong case that what we say about the origins of metabolism is true," says Ralser. His team took chemicals involved in the cycle and exposed them to chemicals that would have been present in early oceans. Nothing happened, until they introduced peroxydisulphate, a source of highly reactive agents called sulphate radicals. These radicals would have been found in abundance near hydrothermal vents, which have been proposed as possible locations at which life started. Peroxydisulphate triggered a sequence of 24 chemical reactions that were very similar – although not identical – to those seen in Krebs cycle today. "The most surprising thing is that a single molecule acts as a catalyst for all of the reactions we discovered." Ralser believes that these hardwired reactions provided a template upon which the evolutionary machinery could build once it came into being.

"With the metabolic pathway alone, you have a very good starting point for life, but it is not life," says Ralser. You also need things like membranes and genetic machinery. "How do you bring these elements together and make them work?" he asks. "This is still a big challenge."

(Adapted from https://www.newscientist.com)

a. Define the term metabolism (line 3). (1)

b. Explain what is meant by "RNA is needed for enzyme production" (line 4). (1)

c. Lines 5-7 describe one issue with the "RNA first" hypothesis.
   i. What "survival advantage" (line 6) might the Krebs cycle reactions have provided to early life form? (1)
   ii. Suggest another problem with this hypothesis. (1)

d. Why is a catalyst (enzymatic or otherwise) so vital in Krebs cycle? (1)

e. Name the "starting material for glycolysis" (line 15). (1)

f. In which parts of modern-day eukaryotic cells do glycolysis and Krebs cycle occur? (2)

g. Enzymes can provide a selective advantage by providing more control over a cycle. One such enzyme is the one that catalyses the phosphorylation of hexose molecules during glycolysis. Name this enzyme and briefly explain how it controls respiration. (3)

h. i. Is glycolysis an anabolic or a catabolic process? (1)
   ii. What name is given to the process whereby glucose is produced from non-carbohydrate precursors in modern-day eukaryotic cells? (1)
   iii. Explain in detail the process named in part h(ii) as it happens in the human body. Refer to location where it occurs, conditions under which it happens and hormones involved in bringing it about. (4)

i. The sequence of reactions that were catalysed by peroxydisulphate in Earth's early environment were very similar but "not identical" to those seen in Krebs cycle today (lines 26,27). What forced the development of the Krebs cycle from a primitive sequence of reactions over time? (1)

j. One difference between Earth's early and current atmosphere is that the former lacked oxygen. Describe the role that oxygen plays in modern-day respiration. (2)

k. Explain in detail how glycolysis is linked to the Kreb's cycle in modern-day eukaryotic cells. (3)

l. Ralser explains that apart from metabolic pathways other components "like membranes and genetic machinery" are also needed for the creation of life (line 31). Suggest what role each of these two components would have had in early life forms. (2)

(Total: 25 marks)

Questions continue on next 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. Diffusion plays many important roles in organisms. Discuss this statement with reference to **FIVE** biological systems and/or processes that happen in the human body.

2. Write an essay about cycles in Biology. You are **not** expected to give a detailed description of particular cycles but highlight the importance of cycles in various aspects of Biology.

3. Terrestrial natural habitats in the Maltese islands appear in different stages of ecological succession. Discuss.

4. The body uses a variety of measures to defend itself from pathogens. Give an account of the various defence strategies involved.

(Total: 50 marks)

SECTION C
Answer ONE question from this section.

1. Use your knowledge of Biology to distinguish between the following pairs:
   a. Insecta and Arachnida; (5)
   b. competitive and non-competitive inhibitors; (5)
   c. self pollination and cross pollination; (5)
   d. meiosis I and meiosis II; (5)
   e. homospory and heterospory. (5)

OR

2. Use your knowledge of Biology to explain the following statements.
   a. *Anemonia viridis*, an anemone that is very common in Maltese waters, is a radially symmetric organism that employs a sessile lifestyle. (5)
   b. Angiosperms are better adapted to terrestrial habitats compared to all other plant divisions. (5)
   c. The evolution of vertebrate reproductive systems parallels the transition from water to land. (5)
   d. Proteins within the cell membrane have different roles. (5)
   e. Unlike in asexual reproduction, sexual recombination amplifies the number of possible genotypes, increasing the chances of surviving in unpredictable environments. (5)

(Total: 25 marks)

Index No.:_____ AM 05/III.19m

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2019 FIRST SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	III
DATE:	9th May 2019
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	20	14	16	**50**

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1. This question is about Paper Chromatography

Paper Chromatography was carried out to separate and identify the photosynthetic pigments in the flag leaf of a wheat plant. The flag leaf is known to contribute to 75% up to 80% of the photosynthesis carried out by the plant under study.

The following method was carried out.

- Step 1: The plant material was cut up into small pieces, and ground in a mortar by means of a pestle. Propanone (the extraction solvent) was added to the pulp and grinding continued until the liquid appeared dark green in colour.

- Step 2: A pencil line was drawn on a chromatography paper approximately 1 cm from and parallel to the bottom of the plate.

- Step 3: Using a fine pipette, a tiny drop of leaf extract was transferred onto the middle of the pencil line. It was made sure that the drop was not bigger than 3 mm in diameter.

- Step 4: The spot was left to dry, and another drop was added. This step was repeated for 8-10 times until the final spot was dark green.

- Step 5: An organic solvent was added to a glass vial to a depth of 0.5 cm. The chromatography paper was vertically placed in the vial, held in place by a split bung and attention was paid to ensure that while the plate dipped into the running solvent, the pigment spot was always above the surface of the solvent.

- Step 6: The set-up was left for about 5-10 minutes and the chromatogram started to develop. When the solvent front was about 1 cm from the bottom of the bung, the chromatography paper was removed from the vial and placed on a white tile. The location of the solvent front was immediately marked with a pencil, before the solvent evaporated.

Figure 1 shows the Chromatogram obtained in this experiment. Eight different pigments (A-H) were separated on the chromatography paper.

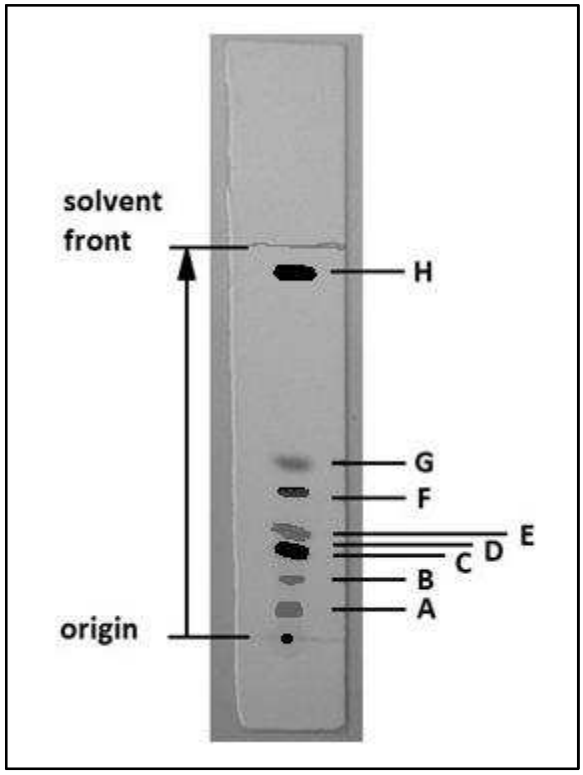

Figure 1: Experiment Results – Chromatogram
(Modified from: http://www.saps.org.uk)

a. Why was the flag leaf used in this experiment and not any other part of the wheat plant?

(2)

b. Explain why the crushing of plant leaves prior to the addition of propanone is important for the successful extraction of pigments.

(1)

Question continues on next page

c. Explain why a pencil was used to mark the positions on the chromatography paper rather than a pen.

_____

_____

_____ (1)

d. How does Step 4 of this method affect the size and concentration of the extract spot? Explain how this step ensures good separation of pigments.

_____

_____

_____

_____

_____ (2)

e. What is the importance of having the spot of plant extract above the surface of the solvent when the chromatography paper is placed in the glass vial?

_____

_____

_____(1)

f. Table 1 *(next page)* lists the distance moved by each photosynthetic pigment (A to H) along the chromatography paper. The solvent front was measured at 8.8 cm from the origin.

Using the formula below, calculate the Rf values for each of the eight pigments. Write down your answers in the column titled Rf value in Table 1.

$$\text{Rf value} = \frac{\text{distance moved by the substance from the origin}}{\text{distance moved by the solvent from the origin}}$$

Table 1: Movement of Pigments along the chromatography paper
(Source: http://www.saps.org.uk)

Pigment	Distance moved from the origin	Rf value
A	0.5 cm	
B	1.2 cm	
C	1.8 cm	
D	2.2 cm	
E	2.3 cm	
F	3.1 cm	
G	3.8 cm	
H	7.9 cm	

(4)

g. Use the information provided in Table 2 below and the Rf values calculated in part (f) above, to identify the photosynthetic pigments A to H. Give the name of each pigment. Write down your answer in Table 3 *(next page)*.

Table 2: Typical Rf value ranges shown by Photosynthetic Pigments in this Solvent
(Source: http://www.saps.org.uk/secondary/teaching-resources/1347-a-level-set-practials-tlc)

Pigment	Rf value range	Colour	Relative position
Carotene	0.89-0.98	Yellow	Very close to the solvent front
Pheophytin a	0.42-0.49	Grey	Below the yellow, above the greens
Pheophytin b	0.33-0.40	Brown	Below the yellow, above the greens
Chlorophyll a	0.24-0.30	Blue green	Above the other green, below the grey
Chlorophyll b	0.20-0.26	Green	Below the other green
Xanthophylls:			
Lutein	0.22-0.28	Yellow	Below, or almost at the same level of, the highest green
Violaxanthin	0.13-0.19	Yellow	Below, or almost at the same level of, the highest green
Neoxanthin	0.04-0.09	Yellow	Below, or almost at the same level of, the highest green

Question continues on next page

Table 3: Identification of Pigments A-H

Pigment	Name
A	
B	
C	
D	
E	
F	
G	
H	

(4)

h. If pigments of different colours were present in the extract, why did the plant extract appear green?

_____

_____

_____

_____ (1)

i. The three factors that influence the distance travelled by individual pigments during paper chromatography are:

- solubility in solvent;
- interaction with the chromatography paper; and
- size of the molecule.

What does a small Rf value indicate about the characteristics of a moving pigment with regards to the three factors described above?

_____

_____

_____

_____(3)

j. Is it possible to have a Rf value greater than one? Give a reason for your answer.

_____

_____

_____ (1)

(Total: 20 marks)

2. This question is about human thermoregulation.

A study was carried out to investigate human thermoregulation and changes in body temperature during exercise. The main aim of this study was to determine the risks of heat injury, associated with physical exercise in different environmental settings.

Heat injury can be categorised as mild, such as heat cramps (brought about by lost fluids during exercise) or severe such as heat stroke (when the body temperature rises higher than 40 °C). The latter can be life-threatening and is considered as a medical emergency.

Nine healthy male athletes were asked to perform a 45-minute run in the outdoor at a temperature 30 °C and relative humidity of 65%. The core body temperature of each athlete was measured at 5-minute intervals using an ingestible telemetric temperature sensor. The mean body temperatures were calculated for each time interval and plotted on a graph as shown in Figure 2.

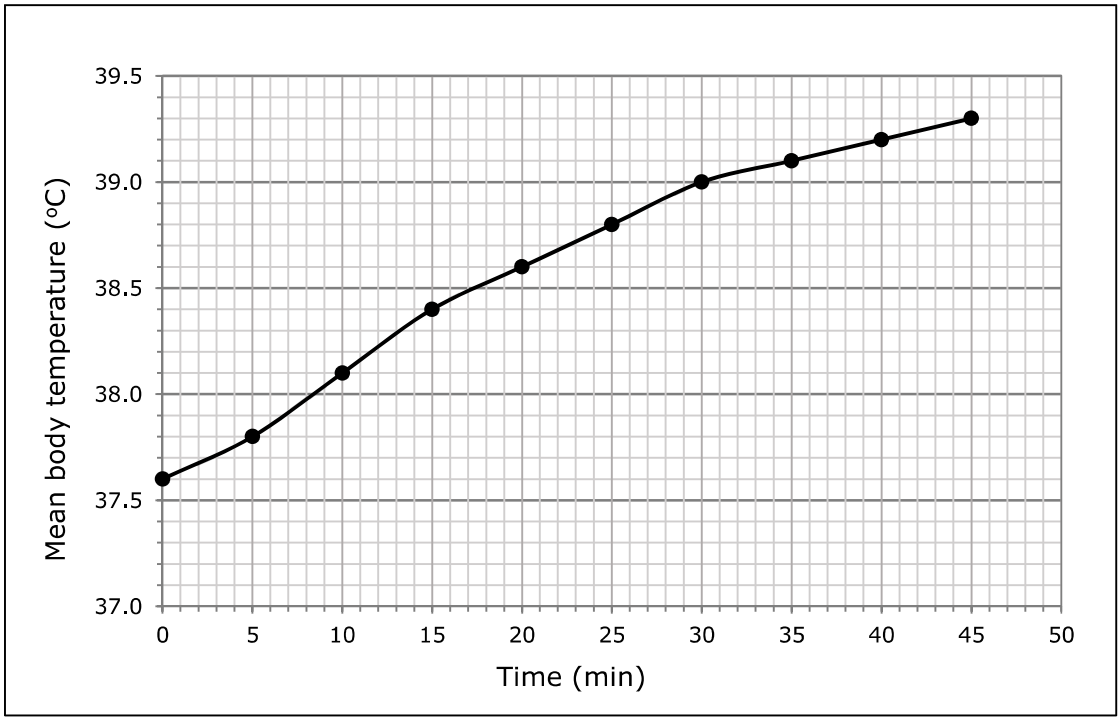

Figure 2: Graph depicting the mean body temperatures during a 45-minute run
(Modified from: https://www.researchgate.net/)

Question continues on next page

a. Calculate the mean body temperature increase after 45 minutes of exercise.

(1)

b. Explain why the core body temperature increases during exercise.

(2)

c. Explain what happens to the trend of temperature increase should these athletes run at a faster pace or extend the run to 60 minutes? Give reasons for your answer.

(2)

d. As part of this study, a sweat test was carried out on all the nine athletes to determine sweating rates associated with physical exercise. Results showed that these athletes lost 1 litre of sweat per hour of exercise at an ambient temperature of 30 °C.

Why does sweating increase during physical exercise? Explain by referring to the relevant thermal properties of water.

(3)

e. Describe **ONE** other mechanism through which the skin acts as a thermoregulatory organ in humans.

_____

_____

_____

_____ (2)

f. The same 45-minute run was carried out by the same athletes at night, in the outdoor at a temperature of 25 °C and relative humidity of 84%. This was done to investigate whether exercising during the night would pose less risks of heat injury for athletes. Body temperatures were measured at 5-minute intervals and results showed that the mean body temperature after 45 minutes (39.6 °C) was higher than the one obtained in the first study.

i. Provide an explanation for this result.

_____

_____

_____

_____

_____ (2)

ii. Give a suitable conclusion with regards to safety of night-time training.

_____

_____

_____ (1)

g. Why is good hydration during physical exercise important to prevent heat injury?

_____

_____

_____

_____ (1)

(Total: 14 marks)

3. This question is about the cell cycle

a. Describe how you would prepare a squash slide of cells found in the onion root tip, to be used for the identification of the various stages of mitosis.

(6)

b. Explain why the root tips are the only part of the onion root that are suitable for this investigation.

(2)

c. What was the main function of each of the **TWO** reagents used in the preparation of this squash slide?

(2)

d. Why is the squashing step essential for this analysis?

_____

_____

_____ (1)

e. The five photomicrographs of onion root cells, shown in Figure 3, display different stages of the cell cycle encircled in white. Identify stages A to E.

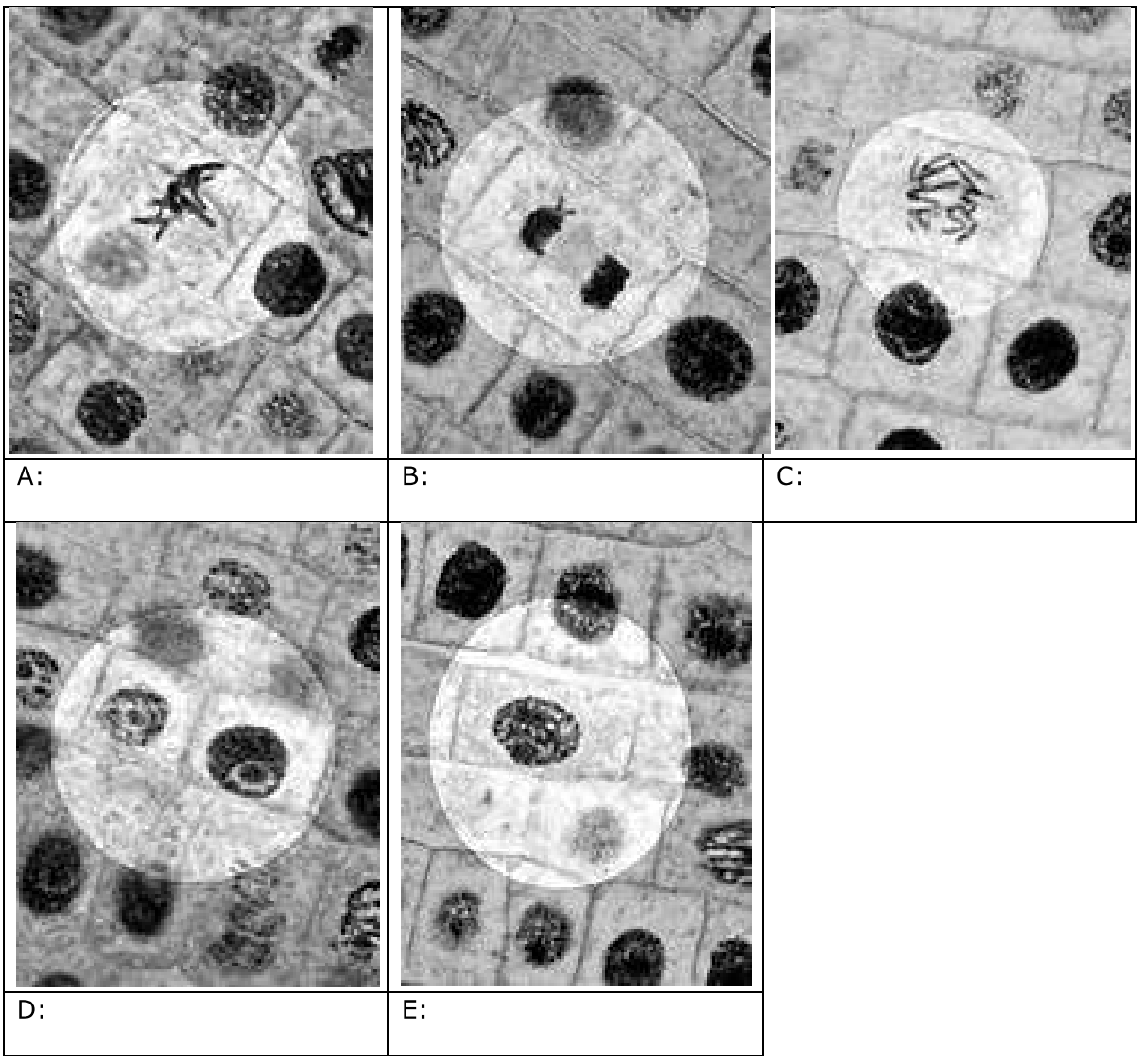

Figure 3: Photomicrographs showing different stages of the cell cycle in onion root cells.
(Modified from: http://www.microscopy-uk.org.uk)

(5)

(Total: 16 marks)

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L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2019 FIRST SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IV – *Practical*
DATE:	6th June 2019
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. *Saccharomyces cerevisiae* (yeast) is a facultative anaerobe that can grow equally well aerobically and anaerobically in the presence of glucose. The rate at which carbon dioxide is produced can be monitored due to an increase in the acidity of the sugar/yeast mixture. Alkaline phenolphthalein can be used as an indicator to monitor the progress of carbon dioxide release. As the acidity of the sugar/yeast mixture increases the pink colour of the alkaline phenolphthalein indicator is decolourised, that is, the pink colour fades away.

   You are required to devise and implement an experiment to test whether the rate of respiration is dependent on the concentration of glucose that is used as substrate.

   You are provided with the following materials:
   a. a suspension of yeast cells;
   b. phenolphthalein indicator made alkaline with sodium hydroxide;
   c. glucose solutions (1%, 2%, 4%, 6%);
   d. distilled water;
   e. other laboratory apparatus as required.

   Candidates are advised to use 2 cm^3 of each solution during this experiment.

   a. State the aim of your biological investigation.

   _____

   _____

   _____ (1)

   b. Suggest suitable null and alternative hypotheses for this investigation.

   _____

   _____

   _____

   _____ (2)

c. Using the material provided, devise and describe an experimental procedure that may be used in order to investigate the effect of different concentrations of glucose on the rate of respiration.

(12)

Question continues on next page.

d. List and justify **TWO** precautions that should be taken during the experiment.

_____

_____

_____

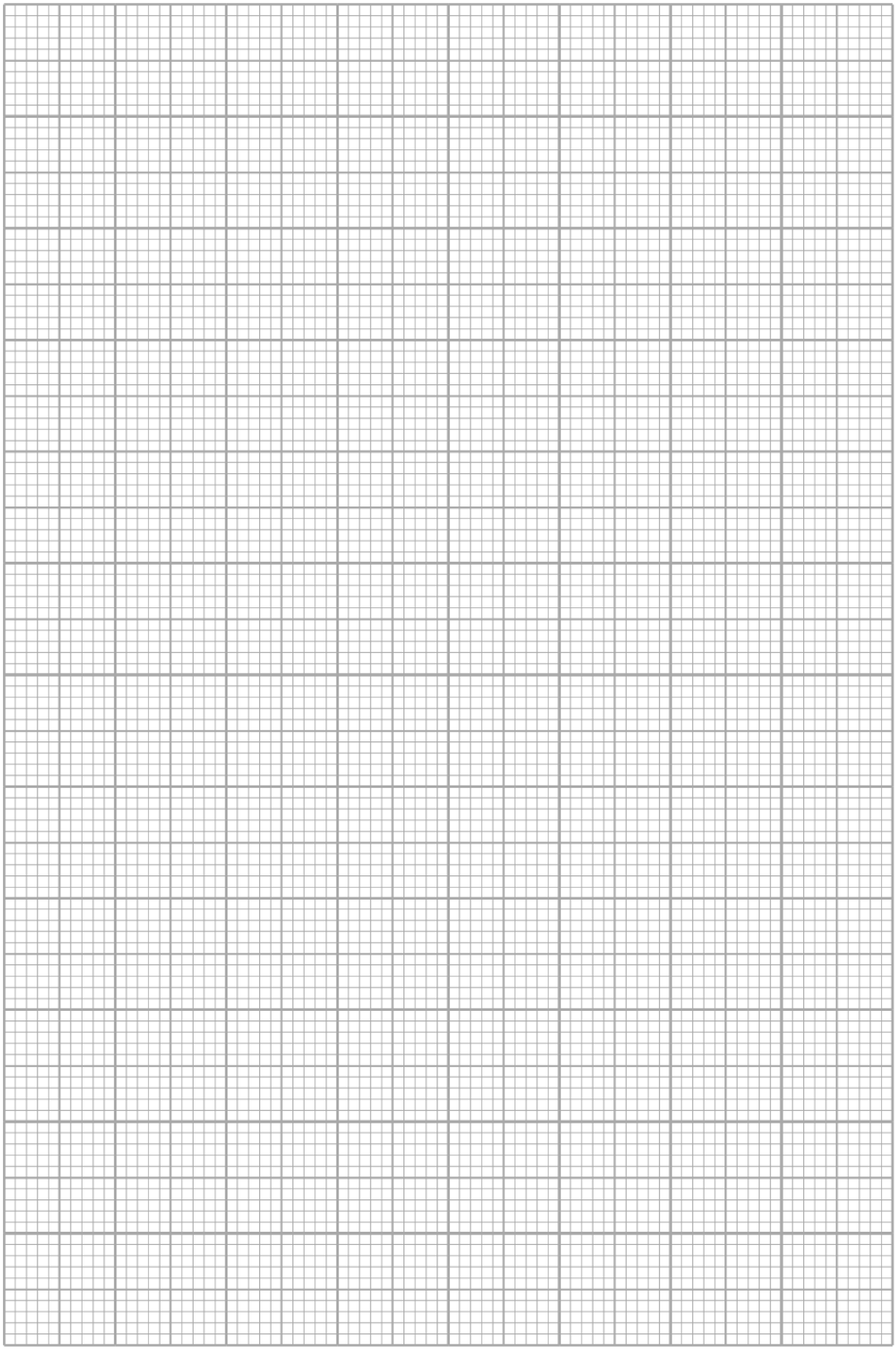
_____ (4)

e. Devise and compile a suitable table for recording your results. Do **NOT** enter any results in the table at this stage. Use the space below for the results table.

(6)

Carry out the investigation that you devised and insert the results in the table you prepared as your answer to part (e).

f. Use the graph paper below to draw a graph of rate of reaction against glucose concentration. (6)



g. Briefly describe any trend that emerges from your graph.

(3)

h. Interpret, in biological terms, any trends in the results that you obtained.

(4)

i. List **TWO** sources of error in your investigation.

(2)

(Total: 40 marks)

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