

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2016

SUBJECT:	BIOLOGY
PAPER NUMBER:	I
DATE:	2 nd September 2016
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	9	10	11	Total
Score												
Maximum	8	10	8	9	11	13	7	8	9	8	9	100

1. This question is about classification.

1.1. List TWO main characteristics of the following phyla/divisions.

1.1.i. Phylum Platyhelminthes;

[two marks]

1.1.ii. Division Bryophyta;

[two marks]

1.1.iii. Phylum Annelida;

[two marks]

1.1.iv. Phylum Chordata.

[two marks]

[Total: Eight marks]

2. This question is about biomolecules.

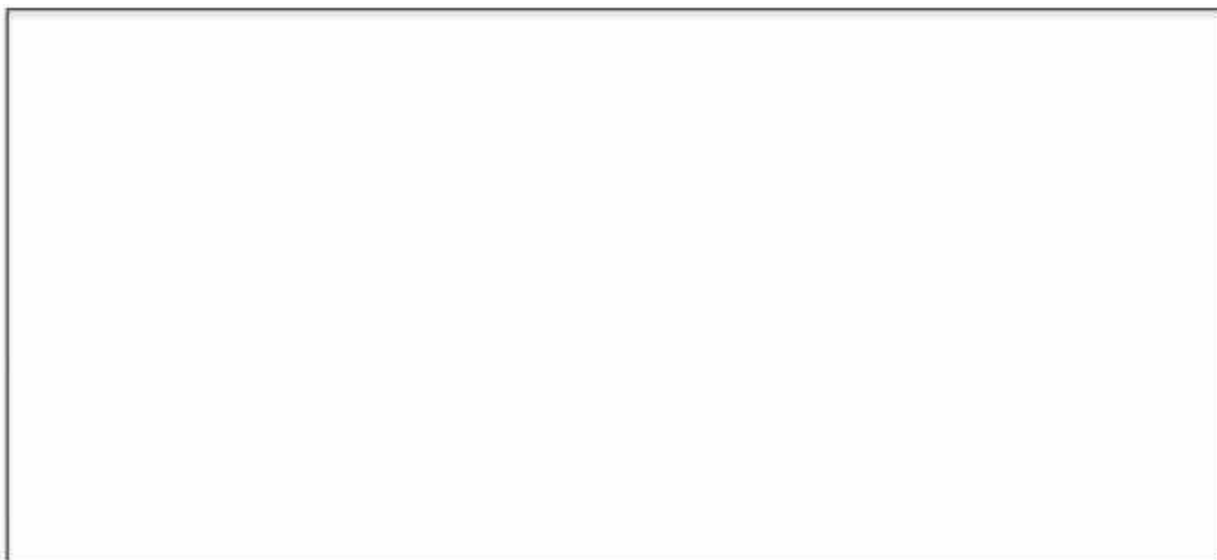
2.1. Fill in the table below by ticking (✓) whether the statements are True or False.

Statement	True	False
The elements in lipids are carbon, oxygen and hydrogen.		
Triglycerides are insoluble in water.		
Glycogen contains polypeptide bonds.		
Glycogen is found in animals only.		
Thymine, uracil and adenine are all examples of purines		

[five marks]

Proteins are made up from many amino acids attached together.

2.2. Draw the molecular diagram of the product formed when two amino acids react together.



[two marks]

2.3. What type of reaction forms a dipeptide?

_____ [one mark]

2.4. Mention TWO functions of the R group in proteins.

[two marks]

[Total: Ten marks]

Please turn the page.

DO NOT WRITE ABOVE THIS LINE

3. This question is about hormonal control and nervous system.

3.1. Define the term *tropic hormone*.

[one mark]

3.2. List TWO tropic hormones secreted by the anterior pituitary gland.

[two marks]

3.3. Briefly explain, using ONE example, the principle of negative feedback.

[three marks]

3.4. List TWO differences between the *nervous system* and the *endocrine system*.

[two marks]
[Total: Eight marks]

DO NOT WRITE ABOVE THIS LINE

4. This question is about gaseous exchange.

4.1. State TWO functions of the cilia which cover the respiratory passages.

[two marks]

4.2. List and explain TWO characteristics of gas exchange surfaces.

[four marks]

4.3. Give a brief description of the tracheal system in insects.

[three marks]

[Total: Nine marks]

Please turn the page.

DO NOT WRITE ABOVE THIS LINE

5. This question is about photosynthesis

5.1. What is a *photosynthetic pigment*?

[one mark]

5.2. What is the difference between *primary* and *accessory* pigments?

[two marks]

Figure 1 shows the absorption spectra of three photosynthetic pigments.

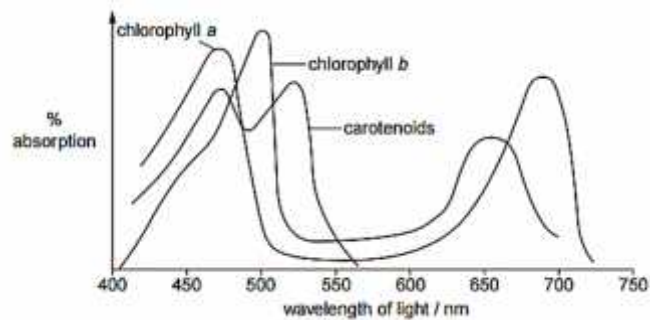


Figure 1 Absorption spectra of three photosynthetic pigments

5.3. Interpret the absorption spectrum of chlorophyll a.

[three marks]

5.4. Briefly describe the role played by chlorophyll in photosynthesis.

[three marks]

5.5. Photosynthesis consists of light-dependent reactions and light-independent reactions. Give the precise location where these reactions occur.

[two marks]
[Total: Eleven marks]

6. This question is about cellular division and genetics.
6.1. List THREE differences between mitosis in plant and animal cells.

[three marks]

6.2. Explain the difference between the following:

6.2.i. Gene and Allele;

[two marks]

Please turn the page.

DO NOT WRITE ABOVE THIS LINE

6.2.ii. Codominance and incomplete dominance;

[two marks]

6.2.iii. Sex-linked inheritance and autosomal inheritance.

[two marks]

6.3. Haemophilia is a sex-linked condition, with the allele linked to the X chromosome. A woman carrying the haemophilia allele has a child with a father who does not have the condition. What is the probability of their first child having haemophilia?

[four marks]

[Total: Thirteen marks]

7. This question is about biotechnology.

The polymerase chain reaction (PCR) is a technique used to obtain many copies of a particular gene.

7.1. Explain how the strands of DNA are separated during the PCR.

[two marks]

7.2. In a particular PCR, two different primers are added to the DNA.

7.2.i. What are *primers*?

[one mark]

7.2.ii. Explain why two primers are added.

[two marks]

7.3. Starting with a single molecule of DNA, the polymerase chain reaction was allowed to go through three complete cycles. How many molecules of DNA would be produced? Explain your answer.

[two marks]

[Total: Seven marks]

8. This question is about reproduction.

8.1. Define the term *vegetative propagation*.

[two marks]

8.2. Give TWO examples of organs of vegetative propagation.

[two marks]

8.3. In the space provided below, draw an annotated diagram of a mature human sperm.



[four marks]
[Total: Eight marks]

DO NOT WRITE ABOVE THIS LINE

9. This question is about protein metabolism and excretion.

9.1. Distinguish between *transamination* and *deamination*.

[two marks]

9.2. Explain why the main nitrogenous excretory product of humans is not ammonia.

[three marks]

9.3.i. Mammals produce a compound when ammonia joins with carbon dioxide. Name the compound produced when this reaction takes place.

[one mark]

9.3.ii. State the metabolic pathway in which the product in **question 9.3.i.** is produced.

[one mark]

9.3.iii. Apart from ammonia and carbon dioxide, there are other reactants which are involved in the pathway mentioned as an answer to **question 9.3.ii.** State any TWO other reactants.

[two marks]
[Total: Nine marks]

10. This question is about the immune system.

Influenza is an acute viral infection that primarily attacks the upper respiratory tract, including the nose, throat, bronchi and, less frequently, the lungs. The World Health Organisation (WHO) states that the most effective way to prevent the disease or severe outcomes from the illness is through vaccination.

(adapted from <http://www.euro.who.int/en/health-topics/communicable-diseases/influenza/data-and-statistics>)

- 10.1. State the part of the vaccination which triggers the immune system?

[one mark]

- 10.2. Explain why after getting the seasonal flu vaccine, some people still get sick with influenza.

[one mark]

- 10.3. Complete the following table using a tick (✓) to indicate whether each of the statements are True or False.

Statement	True	False
Lymphocytes produce antibodies which attach to specific antigens.		
The resistance to an infection by a certain pathogen that is obtained by being injected with a weakened pathogen or having the disease is known as passive immunity.		
A phagocyte is a type of leucocyte which produces antibodies.		
Activated lymphocytes divide to produce specific cells, such as memory cells.		
When a person acquires antibodies from other organisms, they are actively immune to certain pathogens.		
Passive immunity is a long-lasting type of immunity compared to active immunity.		

[six marks]

[Total: Eight marks]

DO NOT WRITE ABOVE THIS LINE

11. This question is about evolution.

11.1. Explain the term *natural selection*.

[two marks]

11.2. List the THREE types of selection processes occurring in natural and artificial populations.

[three marks]

11.3. For each of the following, state the type of selection and explain each example.

11.3.i. Babies who are born above or below the average birth weight are less likely to survive.

Type of selection: _____

Explanation: _____

[two marks]

11.3.ii. New strains of bacteria are a result of antibiotics misuse.

Type of selection: _____

Explanation: _____

[two marks]

[Total: Nine marks]

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2016

SUBJECT:	BIOLOGY
PAPER NUMBER:	II
DATE:	3 rd September 2016
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.*
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 - *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.

Number of wild bees drops where they are needed most

5 Wild bees, like the common bumblebee (*Bombus impatiens*), help pollinate food crops across the United States. But a new computer model shows that wild bee populations are declining in parts of the United States, largely due to habitat loss in areas with intense farming. The research team, led by Insu Koh at the University of Vermont, estimates that wild bee abundance between 2008 and 2013 declined in 23% of the contiguous U.S.

10 Areas with the lowest relative wild bee abundance were those with the most agriculture, in the Midwest's Corn Belt and California's Central Valley, for instance. These areas of mismatch, which include farms that grow fruits and nuts, produce 39% of crops in the United States that depend on pollinators. A lack of wild bees could increase costs for farmers who will need to truck in domesticated honeybees to pollinate crops or face lower food yields, ecologist Taylor Ricketts says.

15 Many studies have focused on the pollination and population patterns of domesticated honeybees. But like honeybees, wild bees are important pollinators of food crops. Pesticides, climate change, and diseases threaten wild bees—but the new study also shows that their decline may be caused by the conversion of bee habitat into cropland. In eleven key states where the new study shows bees in decline, the amount of land tilled to grow corn spiked by 200% in five years—replacing grasslands and pastures that once supported bee populations. "These results reinforce recent evidence that increased demand for corn in biofuel production has intensified threats to natural habitats in corn-growing regions," the new study notes. Dropping populations of wild bees in agricultural areas could affect crop pollination and result in higher costs for farmers, researchers report in the Proceedings of
20 the National Academy of Sciences (December 2015).

Creating wild bee habitat on field edges could help maintain wild bee populations and sustain crop pollination, he says. "You grow more abundant bees of diverse kinds and they spill out into your fields."

Adapted from: Samoray, Chris (2015). Science News. <https://www.sciencenews.org/article/number-wild-bees-drops-where-they%E2%80%99re-needed-most?mode=topic&context=76&tgt=nr> and Phys.org (2015). <http://phys.org/news/2015-12-wild-bee-decline-threatens-crop.html>

Using the information from the passage and your own knowledge, answer the following questions.

- 1.1. What phylum and class do bees fall under? [two marks]
- 1.2. Give **THREE** identifying characteristics of the class referred to in **question 1.1**. [three marks]
- 1.3. Explain what is meant by *population* (line 2). [two marks]
- 1.4. Define the term *biodiversity*. [two marks]
- 1.5. A drastic decline in bumblebee numbers could result in a genetic bottleneck. How would this influence the Hardy-Weinberg equilibrium of the bumblebee population? [three marks]
- 1.6. What is *pollination*? (line 11) [two marks]
- 1.7. Give the biological term used to describe insect pollination. [one mark]
- 1.8. Briefly describe the adaptations plants may have towards insect pollination. [four marks]
- 1.9. Briefly explain **THREE** factors listed in the text that may be influencing the population size of wild bees. [six marks]
- [Total: Twenty five marks]**

SECTION B

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

2. Eukaryotic cells are more complex than prokaryotic cells. *Discuss*.
3. Compare and contrast the structure and function of xylem and phloem in plants.
4. Describe the fine structure of vertebrate skeletal muscle and the mechanism through which skeletal muscle contracts.
5. Random mutations are the driving force of evolutionary change. *Discuss*.

[Total: Fifty marks]

Please turn the page.

SECTION C

Answer **ONE** question from this section.

6. Write brief notes on the following:
- 6.1. The leaf structure of marram grass;
 - 6.2. The lacOperon;
 - 6.3. Epistatis;
 - 6.4. The pentadactyl limb;
 - 6.5. The cleidoic egg.

[five marks each]

7. Use your knowledge of biology to explain the following:
- 7.1. A reduction in numbers of small rodents in the wild may result in a population crash of predator species, such as owls.
 - 7.2. Abandoned fields are occupied by a number of “weedy” plant species.
 - 7.3. The population of wall lizards on Filfla is genetically separate from the wall lizards on Malta, Gozo and Comino.
 - 7.4. Some female cats have a *tortoise shell* fur colour, but male cats cannot have this pattern.
 - 7.5. A study revealed that the mean IQ score of a sample of adopted children was closer to the mean IQ score of their adoptive parents than to that of their biological parents.

[five marks each]

[Total: Twenty five marks]

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

**MATRICULATION EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2016**

SUBJECT:	BIOLOGY
PAPER NUMBER:	III
DATE:	5 th September 2016
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	21	15	14	50

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1. A respirometer was set up as shown in **Figure 1** to measure the rate of oxygen consumption by a number of respiring germinating seeds.

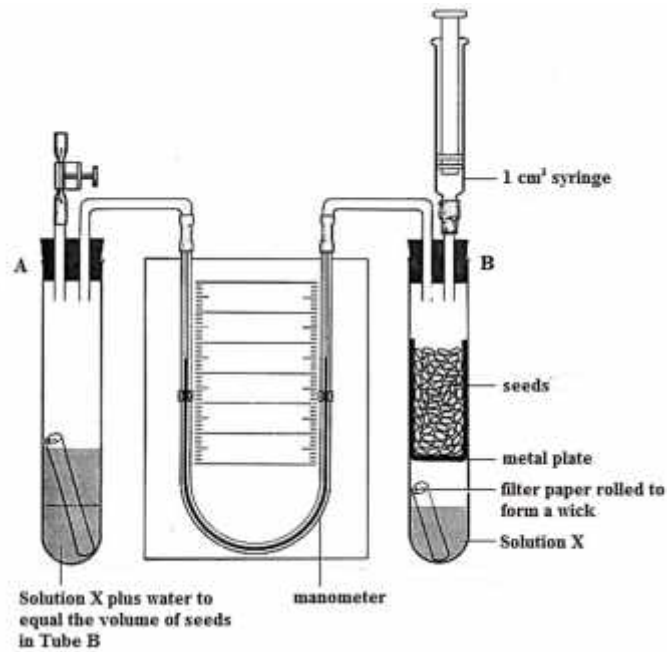


Figure 1: A Respirometer

(adapted from http://www.nuffieldfoundation.org/sites/default/files/PB_measuring-rate-of-metabolism-respirometer2-500.jpg)

- 1.1. Name Solution X and explain its role in the experiment.

[two marks]

- 1.2. What is the use of the metal plate inserted in Tube B?

[one mark]

DO NOT WRITE ABOVE THIS LINE

- 1.3. Prior to placing the seeds in the respirometer, they are first washed with disinfectant solution. Suggest a reason for this treatment.

[two marks]

- 1.4. Explain the TWO main functions of Tube A in this set-up.

[two marks]

Please turn the page

DO NOT WRITE ABOVE THIS LINE

- 1.5. **Table 1** shows the results of this experiment. Use the graph paper (next page), to plot a graph of the volume of oxygen consumed by the germinating seeds with time.

Table 1: Experiment Results

Time (minutes)	Displacement of manometer fluid (mm)	Volume of O ₂ consumed (mm ³)
10	1.25	0.001
20	10.00	0.008
30	17.50	0.014
40	21.25	0.017
50	30.00	0.024
60	36.55	0.029

[five marks]

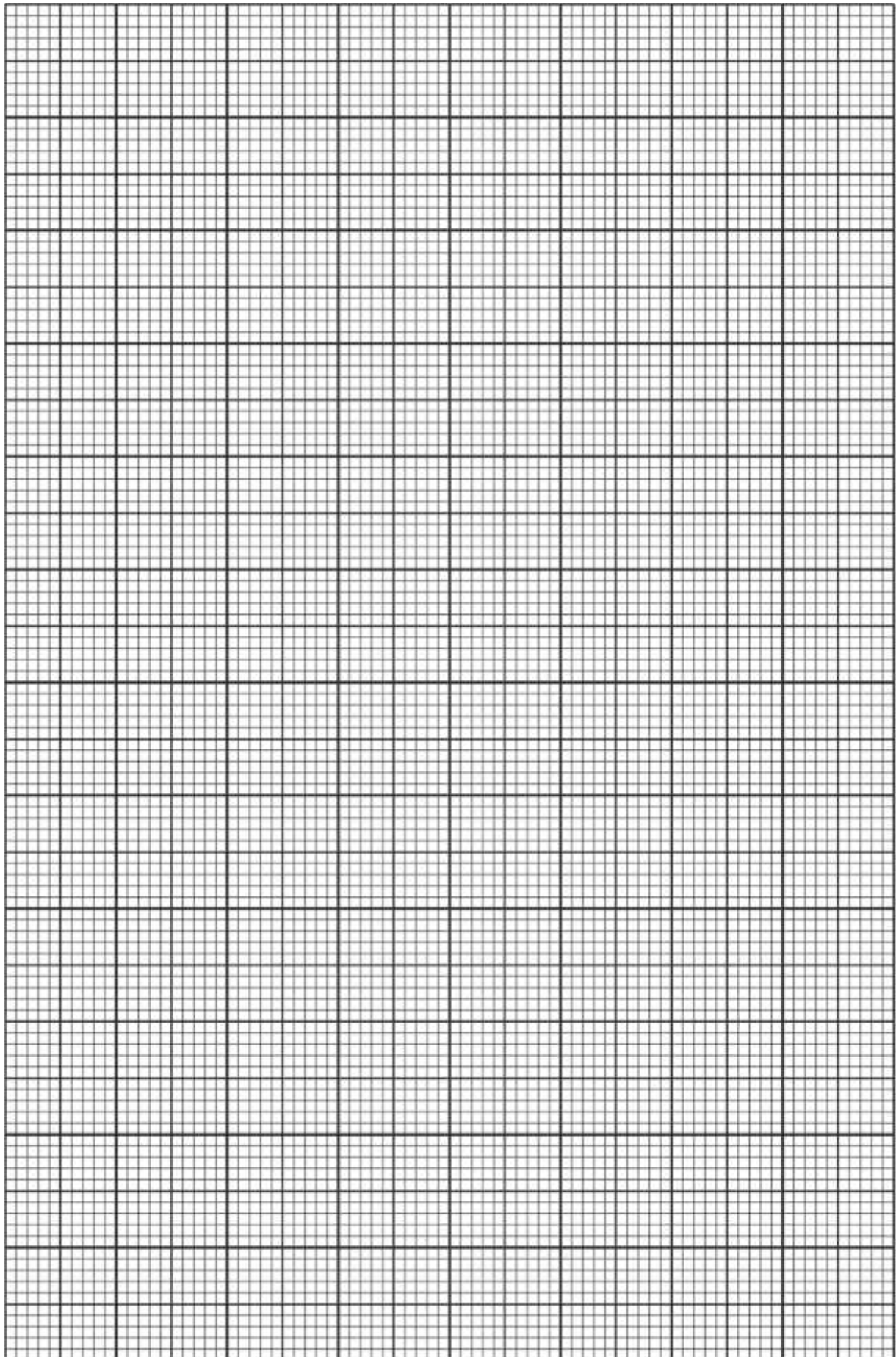
- 1.6. Find the slope (m) of the graph to determine the rate of oxygen consumption in mm³min⁻¹ and convert it to cm³h⁻¹. Show your working.

Formula to find m :

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

[three marks]

DO NOT WRITE ABOVE THIS LINE



DO NOT WRITE ABOVE THIS LINE

1.7. If the weight of the germinating seeds used in this experiment was 5g, calculate the metabolic rate of these organisms (expressed as the volume of oxygen absorbed) in $\text{cm}^3\text{g}^{-1}\text{h}^{-1}$.

[two marks]

1.8. The experiment was repeated at higher temperatures. Explain how the volume of oxygen consumed by the seeds varies.

[four marks]

[Total: Twenty-one marks]

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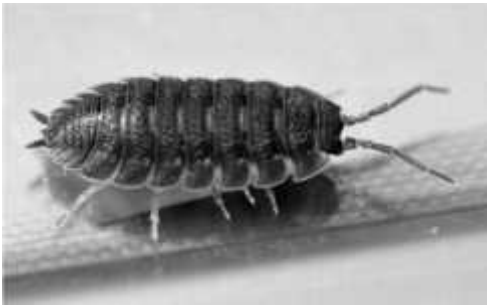


Figure 4

Phylum:	Characteristic Feature:
Class:	

[six marks]
[Total: Fifteen marks]

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3. Organisms inhabiting rocky shores must be adapted to extreme conditions. These include exposure to wave action, salinity, exposure to sunlight, seawater immersion conditions, and different topography and substrata. Water movement associated with tides, wave and sea-spray, makes rocky shores neither fully terrestrial nor fully marine habitats. Therefore the biotic assemblages inhabiting rocky shores do not survive full immersion or full emersion, but conditions of wetness between these two extremes.

A marine ecologist wanted to study the ecology and diversity of flora on Limestone rocky shores. The main objective of this study was to identify and estimate the abundance of floral species along three different ecological zones of the shore:

- a) the lower shore zone (lower mediolittoral zone), characterised by high exposure to wave action and long immersion periods in sea water;
- b) the medium shore zone (upper mediolittoral zone), considered as a transitional area since it is characterised by some immersion in seawater and dry periods; and
- c) the upper shore zone (supralittoral zone), characterised by some degree of wetting through sea-spray but no immersion.

3.1. Describe the sampling method used to sample the sessile biota of interest (both qualitatively and quantitatively), along these three different shore zones (starting from the shoreline and moving upwards; perpendicular to the shoreline).

[five marks]

DO NOT WRITE ABOVE THIS LINE

3.3. Using the results obtained in **question 3.2**, which shore zone shows the highest species diversity? Explain how this result was expected given the species richness and species evenness of that particular zone.

[three marks]
[Total: Fourteen marks]

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2016

SUBJECT:	BIOLOGY
PAPER NUMBER:	IV – Practical
DATE:	29 th August 2016
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

1.4. 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.

--

[four marks]

Carry out the investigation that you devised and insert the results in the table you prepared as your answer to Question 1.4.

1.5.i. Calculate the mean total surface area of Species A.

[three marks]

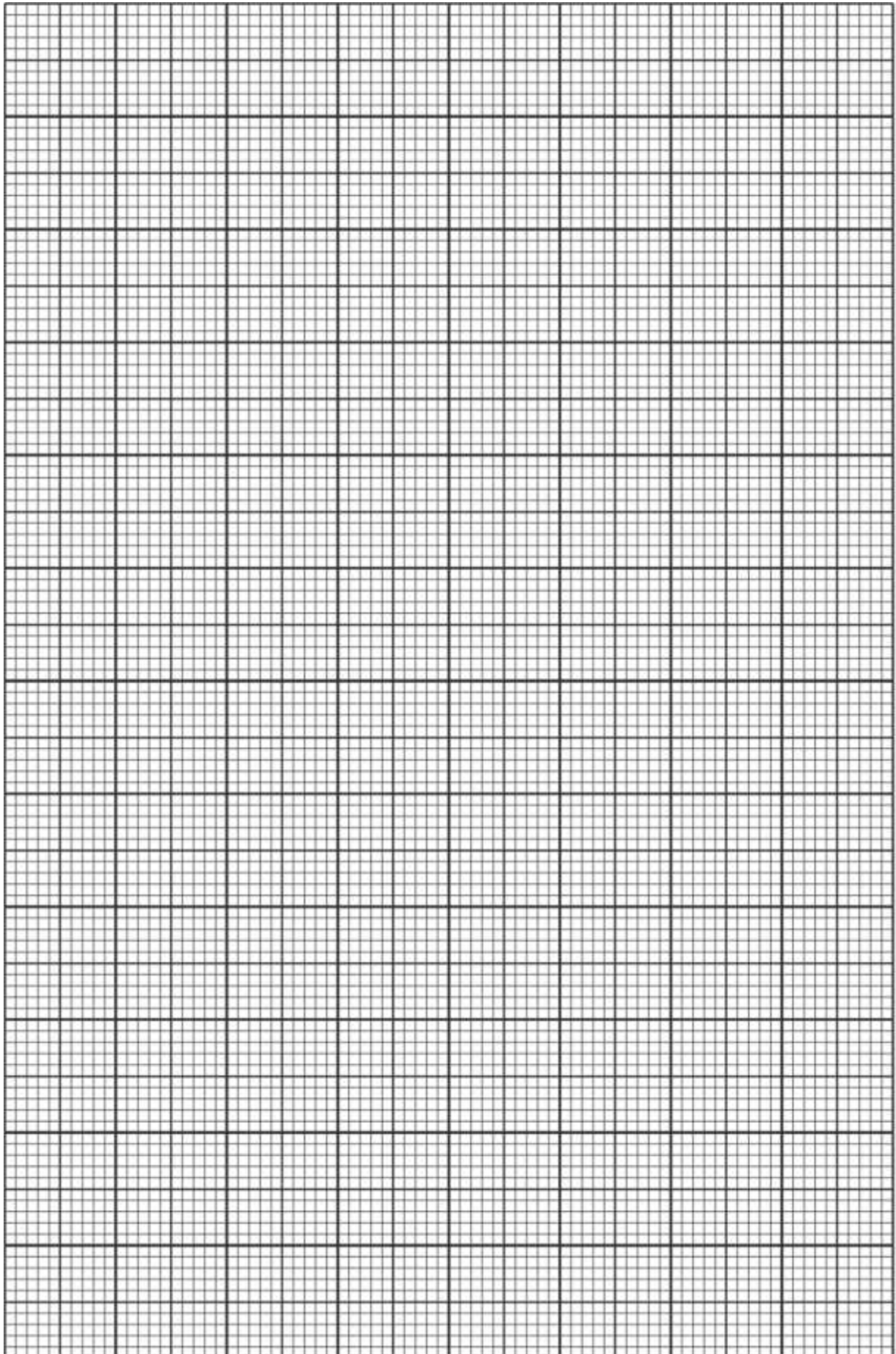
1.5.ii. Calculate the mean total surface area of Species B.

[three marks]

Please turn the page

1.6. Use the graph paper below to draw a bar chart to represent your results.

[six marks]



1.7. From **your** results, deduce which plant is better adapted to xerophytic conditions.

[four marks]

1.8. Suggest a statistical test that can be used to test your hypothesis as an answer to **Question 1.2**. Explain why this test was chosen.

[three marks]

1.9. List **THREE** adaptations that plants may use to survive in xerophytic conditions.

[three marks]
[Total: Forty marks]

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