

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2015

SUBJECT:	BIOLOGY
PAPER NUMBER:	I
DATE:	6 th May 2015
TIME:	9.00 a.m. to 12.00 noon

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	Total
Score											
Maximum	9	9	6	12	10	13	10	12	9	10	100

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1. This question concerns cells.

1.1. What is a *prokaryotic cell*?

[two marks]

1.2. Eukaryotic cells have a different organization than prokaryotic cells. Suggest TWO evolutionary advantages of eukaryotic cells over prokaryotic cells.

[two marks]

1.3. Why can a eukaryotic cell achieve a larger size than a prokaryotic cell?

[two marks]

The diagram below shows a cross-section of an organelle that is commonly found in eukaryotic cells:

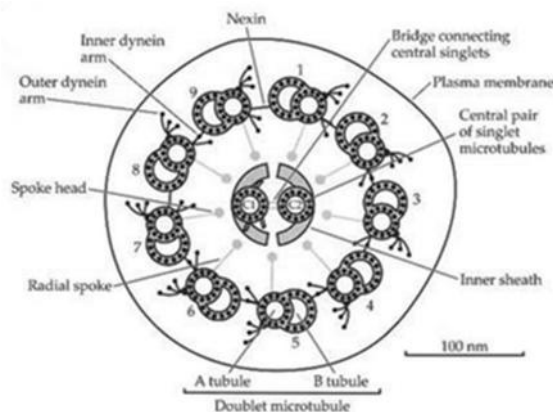


Figure 1 adapted from <http://wasdarwinwrong.com/korthof8.htm>

1.4. What organelle is shown in **Figure 1**?

[one mark]

DO NOT WRITE ABOVE THIS LINE

1.5. Name ONE function of this organelle in eukaryotic organisms.

[one mark]

1.6. Name ONE eukaryotic cell in which this organelle is found.

[one mark]

[Total: Nine marks]

2. This question concerns enzymes.

2.1. Briefly explain the importance of the shape of the enzyme in relation to its function.

[two marks]

2.2. Compare the *lock and key* and *induced fit* hypotheses.

[two marks]

The activity of cellulase was measured at different temperatures. The pH level was kept constant. The results are shown in **Figure 2**.

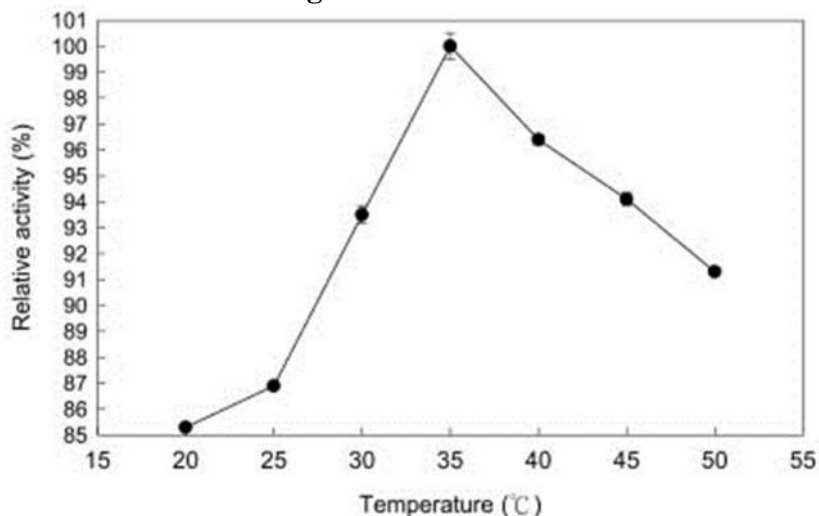


Figure 2 adapted from <http://ejournal.sinica.edu.tw/bbas/content/2004/2/1471-fi8.JPG>

DO NOT WRITE ABOVE THIS LINE

2.3. With reference to **Figure 2**, describe and explain the effect of temperature on the activity of cellulase.

[four marks]

2.4. Why was the pH kept constant?

[one mark]

[Total: Nine marks]

3. This question concerns the circulatory system.

Figure 3 below represents the relative thickness of the walls of the three chambers of the heart:

- Right ventricle
- Right atrium
- Left ventricle

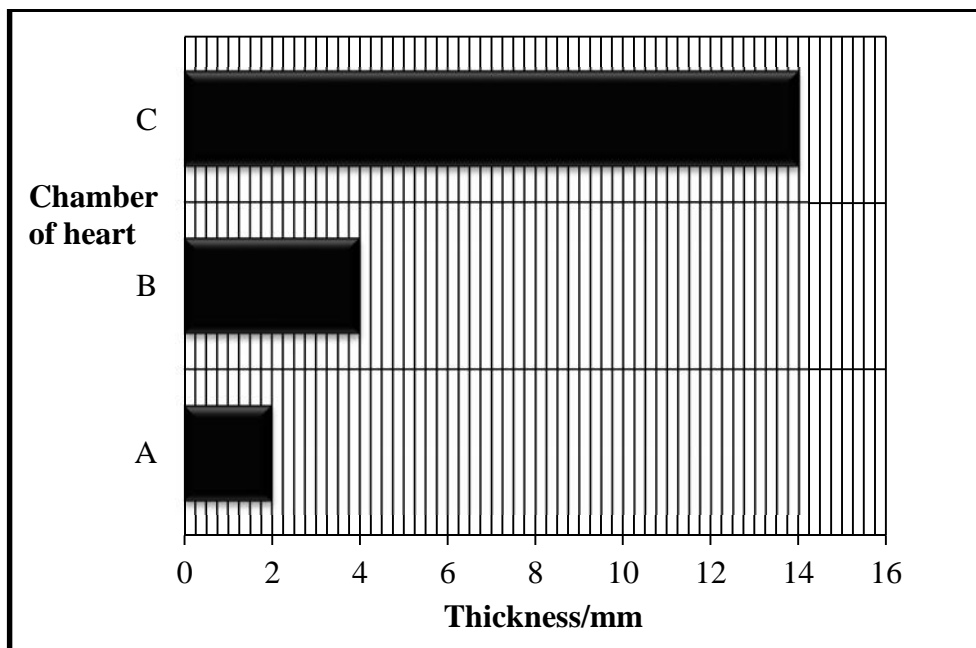


Figure 3

DO NOT WRITE ABOVE THIS LINE

3.1. State which of these chambers are identified by the letters A, B and C in **Figure 3**.

A _____
B _____
C _____

[three marks]

3.2. Explain why the chamber wall increases in thickness from chamber A to chamber B to chamber C.

[three marks]
[Total: Six marks]

4. This question concerns the nervous system.

4.1. Give a definition of *action potential*.

[two marks]

Figure 4 shows the changes in permeability of the membrane to sodium ions (Na^+) and to potassium ions (K^+) during a single action potential.

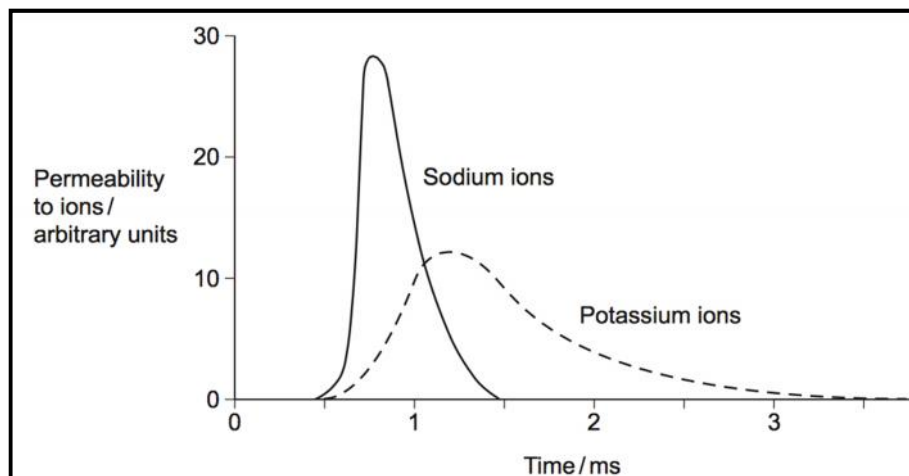


Figure 4

DO NOT WRITE ABOVE THIS LINE

4.2. By referring to **Figure 4**, explain the role of sodium ions during an action potential.

[four marks]

4.3. Explain why during an action potential the membrane potential rises to +40mV and then drops.

[four marks]

4.4. ATP is used to re-establish the resting potential in axons. Explain how this is achieved.

[two marks]

[Total: Twelve marks]

5. This question concerns genetics.

5.1. State TWO differences between mitosis and meiosis.

[two marks]

5.2. The table below represents different events during mitosis. Tick [✓] the stage in which each of the following events takes place.

Event	Stage of Mitosis				
	Interphase	Metaphase	Prophase	Telophase	Anaphase
DNA replication occurs					
Chromatids shorten and thicken					
Sister chromatids separate					
Centromeres of chromatids line up across the equator of the spindle					

[four marks]

5.3. State whether these statements are true or false. If false, state why. If true, state what happens.

5.3.i. The centromeres split during the anaphase stage of mitosis.

TRUE/FALSE _____

REASON _____

[two marks]

5.3.ii. In meiosis, genetic crossing-over occurs during Prophase II.

TRUE/FALSE _____

REASON _____

[two marks]

[Total: Ten marks]

DO NOT WRITE ABOVE THIS LINE

6. This question is about transpiration.

6.1. Define the term *transpiration*.

[two marks]

6.2. List TWO environmental factors that affect the rate of transpiration.

[two marks]

6.3. Name and briefly describe the THREE simultaneous pathways through which water may move through plant cells, prior to being transpired.

[six marks]

6.4. What is meant by the term *xerophyte*?

[one mark]

6.5. Give TWO examples of adaptations that xerophytes use to prevent water loss.

[two marks]
[Total: Thirteen marks]

DO NOT WRITE ABOVE THIS LINE

7. This question concerns reproductive processes in living organisms.

7.1. Distinguish between sexual and asexual reproduction.

[one mark]

7.2. What is *hermaphroditism*?

[one mark]

7.3. List ONE advantage and ONE disadvantage of asexual reproduction when compared with sexual reproduction.

[two marks]

7.4. Females and males produce different gametes. Name the two processes that produce each type of gamete.

[two marks]

7.5. This part of the question concerns human reproduction.

7.5.i. Which is the main hormone secreted by the Graafian follicle and which is the pituitary hormone responsible for inducing its secretion?

[two mark]

7.5.ii. Outline ONE role of the corpus luteum.

[one mark]

7.5.iii. Give a function of the testis.

[one mark]
 [Total: Ten marks]

8. This question concerns excretion.

8.1. Explain what is meant by the term *excretion*.

[one mark]

Figure 5 shows the structure of a nephron and its associated blood supply.

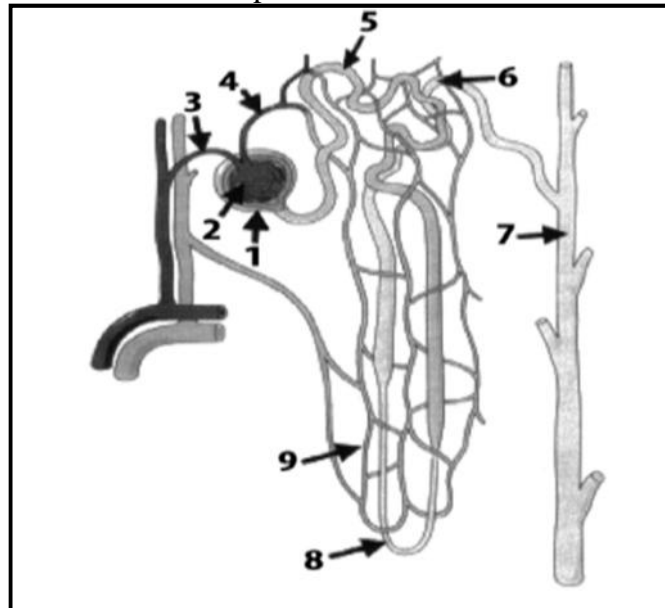


Figure 5

8.2. Name the parts numbered 1 to 4.

1	
2	
3	
4	

[four marks]

DO NOT WRITE ABOVE THIS LINE

8.3. What is re-absorption? In which parts of the nephron does it take place? (You can use the numbers indicated in **Figure 5**)

[five marks]

8.4. What is ultra-filtration?

[one mark]

8.5. The mixture of substances collected at number 1 (Figure 5) was found to have no trace of red blood cells. Give a reason for this observation.

[one mark]

[Total: Twelve marks]

9. This question is about autotrophic nutrition in plants.

9.1. Explain what is meant by *autotrophic nutrition*.

[one mark]

9.2. The leaves have special adaptations to help with photosynthesis. Name TWO adaptations of leaves.

[two marks]

DO NOT WRITE ABOVE THIS LINE

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

[two marks]

- 9.4. Complete the table by ticking [✓] whether the events occur during light-dependent reactions or light-independent reactions or both.

Events	Light-dependent reactions	Light-independent reactions
The splitting of water molecules		
Fixation of carbon		
Calvin cycle		
ATP is broken down		
Oxygen is given off		
ATP is synthesized		
Glucose is formed		
Carbon dioxide binds to RuBP		

[four marks]

[Total: Nine marks]

10. This question concerns local ecological studies.

A group of investigators carried out a survey on flora found on sand-dunes at ir-Ramla l- amra in Gozo. The following results were obtained:

Species	Number of individuals found in sand-dune A	Number of individuals found in sand-dune B
Sea Daffodil	99	18
Sea Medick	140	42
Sea Spurge	8	2
Sand Couch	0	10
Coast Spurge	6	15
Red Campion	1	17

DO NOT WRITE ABOVE THIS LINE

Indices can be used as an estimate of Biological diversity. One such index is the Simpson's Index of Biological diversity (D) which is measured as follows:

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

Where N is the total number of organisms of all species
 n is the total number of organisms of a particular species

10.1. Calculate the Simpson's Index for sand-dune A.

[three marks]

10.2. Calculate the Simpson's Index for sand-dune B.

[three marks]

10.3. Which sand-dune is biologically more diverse? Explain why.

[two marks]

DO NOT WRITE ABOVE THIS LINE

10.4. Indicate why the Simpson's index is not always reliable when a high level of accuracy in the readings of Biological Diversity is required.

[two marks]
[Total: Ten marks]

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UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2015

SUBJECT:	BIOLOGY
PAPER NUMBER:	II
DATE:	7 th May 2015
TIME:	9.00 a.m. to 12.00 noon

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.

Rare Iguana is Endangered Because People Like to Eat Egg-Carrying Females

5 It's a simple equation, really: If a species can't reproduce, it will go extinct. A critically endangered species in Honduras faces that risk in a notable way. It turns out that the people who coexist with Valle de Aguán spiny-tailed iguanas (*Ctenosaura melanosterna*) not only like to eat the lizards but they prefer the taste of females that are carrying eggs. A study uncovering this dangerous preference was published last month in *Herpetological Conservation & Biology*.

According to lead researcher Stesha Pasachnik, a postdoctoral research associate for the San Diego Zoo Institute for Conservation Research, this overharvesting of egg-carrying iguanas "is not only not sustainable but is likely to accelerate this species' extinction due to the loss of gravid females."

10 To assess the threats to this and two other local iguana species, Pasachnik and her fellow researchers visited the Rio Aguán Valley and conducted 132 interviews about how the people there consume the lizards. They found that 68 percent of respondents acknowledged eating *C. melanosterna*, with 26 people saying they ate anywhere from one a year to three a week. The researchers calculated the average annual iguana consumption at more than 15 lizards per person. Although consumption occurs year-round, there is also an annual festival that celebrates eating the iguanas.

15 Of those people who acknowledged eating the species, 60 percent said they preferred to eat egg-carrying females, usually by preparing the eggs and meat in a soup with coconut milk. Some people did it for nourishment. Others cited supposed medicinal qualities ranging from cures for cancer and diabetes to increasing appetite or removing scars.

20 The study did more than just assess this threat to the species. The researchers also asked people how open they would be to efforts to conserve it and found a great deal of support for the idea. The survey found that 80 percent of people in the iguana's range feared that it would go extinct and that 94 percent welcomed international assistance because it could lead to a sustainable harvest that would ensure the iguanas existed for future generations. As the researchers wrote in their paper, "This type of study opens the door to start those conversations with locals such that we may begin to
25 work towards co-management strategies."

30 Of course conserving the species will take more than just stopping a few dozen people from eating it. The valley has also been heavily deforested for banana plantations, cattle and other agriculture, which has destroyed at least 50 percent of the iguana's habitat. Feral dogs, cats and invasive rats are also prevalent in the region. But even with all of those threats, this study reveals that the people of Aguán Valley place value in their local iguanas; that alone is half the battle for conservation.

Platt, John R. (2014). *Scientific American*.

(URL: <http://blogs.scientificamerican.com/extinction-countdown/2014/12/05/iguana-endangered-eating-eggs/>)

- 1.1. What is the genus name of the spiny-tailed iguana and what taxonomic class does it form part of?
[two marks]
- 1.2. Give FOUR identifying characteristics of vertebrates.
[four marks]
- 1.3. What is meant by the term *habitat* (line 29)?
[two marks]
- 1.4. What is meant by *endangered species* (line 1 - 2)?
[two marks]
- 1.5. List and describe THREE causes of species extinction mentioned in this text.
[nine marks]
- 1.6. Give TWO ways in which the harvesting of female iguanas carrying eggs could accelerate extinction.
[four marks]
- 1.7. The long-term stability of the spiny-tailed iguana depends on the population's recruitment. What is *recruitment*?

[two 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. Describe the human liver and its role in the metabolism of proteins, carbohydrates and fats.
3. Compare and contrast gaseous exchange in insects, bony fish and mammals.
4. Give an account of the various stages of protein synthesis.
5. Gene extraction, recombinant DNA formation, introduction of vector DNA into host cell and screening are four main stages in genetic engineering using bacteria. Describe each process stage in detail. In your account include methods and techniques that can be applied at each step.

[Total: fifty marks]

SECTION C

(Answer **ONE** question from this section).

6. **Use your knowledge of Biology to explain the evolutionary significance of the following:**
 - 6.1. the pentadactyl tetrapod limb;
 - 6.2. the transition of gills to lungs;
 - 6.3. the plant vascular system;
 - 6.4. the mammalian closed circulatory system;
 - 6.5. the endosymbiotic origin of plastids and mitochondria.

[five marks each]

7. **Use your knowledge of Biology to explain the following statements.**

- 7.1. In *Escherichia coli*, the lac Operon regulates the encoding of the necessary enzymes to metabolise lactose.
- 7.2. Organisms classified as Protoctista do not all share a common origin.
- 7.3. In primary succession, there is a progressive replacement of one community by another until a climax community is established.
- 7.4. Water is essential for the processes of life.
- 7.5. Starfish and sea-urchins look very different. Yet, they are classified in the same phylum.

[five marks each]

[Total: Twenty five marks]

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2015

SUBJECT:	BIOLOGY
PAPER NUMBER:	III
DATE:	8 th May 2015
TIME:	9.00 a.m. to 10.30 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.
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For examiners' use only:

Question	1	2	3	Total
Score				
Maximum	22	12	16	50

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

1.1. Draw and label a schematic transverse section of:

(a) collenchyma cells and

(b) sclerenchyma cells.

(a)	(b)
-----	-----

[four marks]

1.2. **Figure 1** is a photomicrograph of a transverse section through a herbaceous stem.

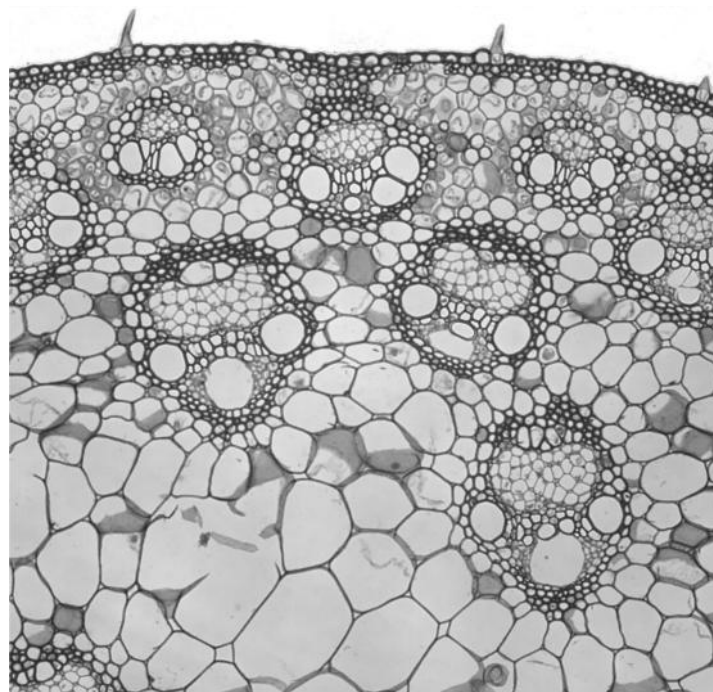


Figure 1: T.S Herbaceous Stem

(Image Source: <http://emp.byui.edu/wellerg/Roots%20and%20Shoots%20Lab/Images/Zea%20Mays%20Stem%20P.jpg>)

Label and annotate this photomicrograph to indicate the following plant tissues:

- (a) parenchyma cells;
- (b) collenchyma cells;
- (c) sclerenchyma cells;
- (d) vascular bundle.

Annotations should describe the function of each cell type.

[four marks]

1.3. Does **Figure 1** show a monocot or a dicot stem? Give ONE reason for your answer.

[two marks]

1.4. **Figure 2** shows a transverse section through a monocot root.

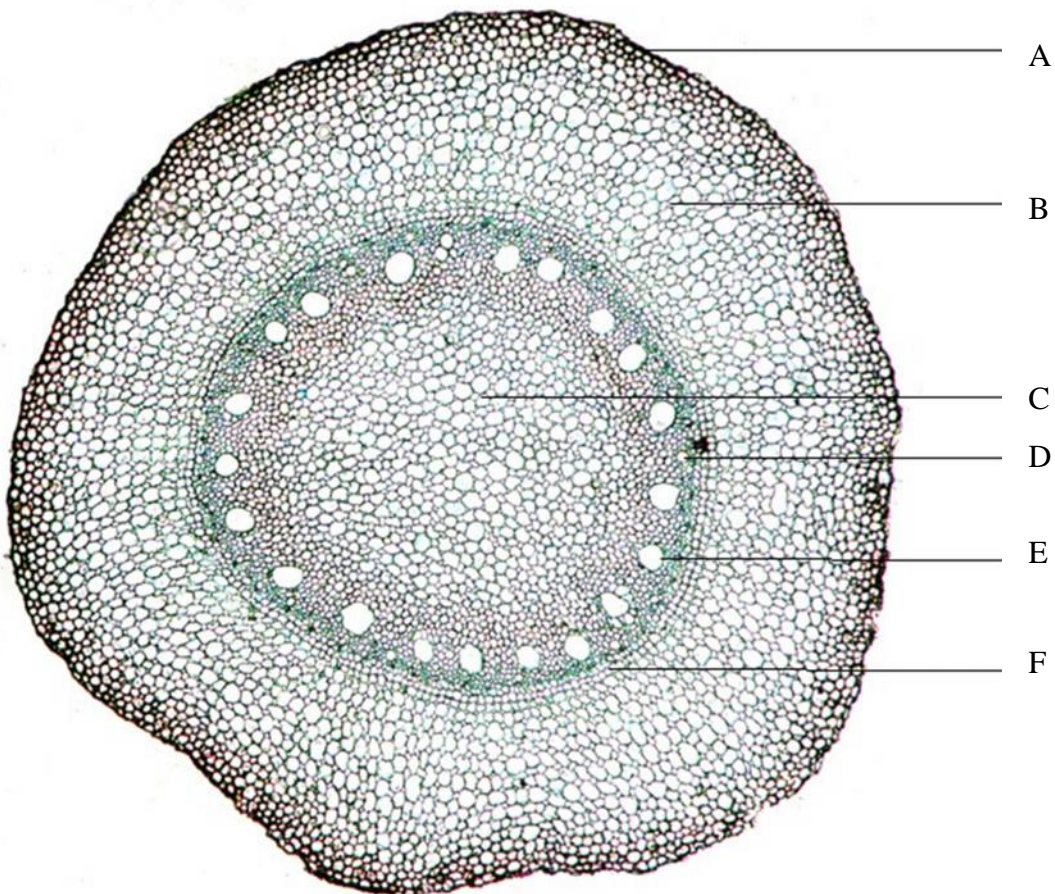


Figure 2: T.S through a monocot root

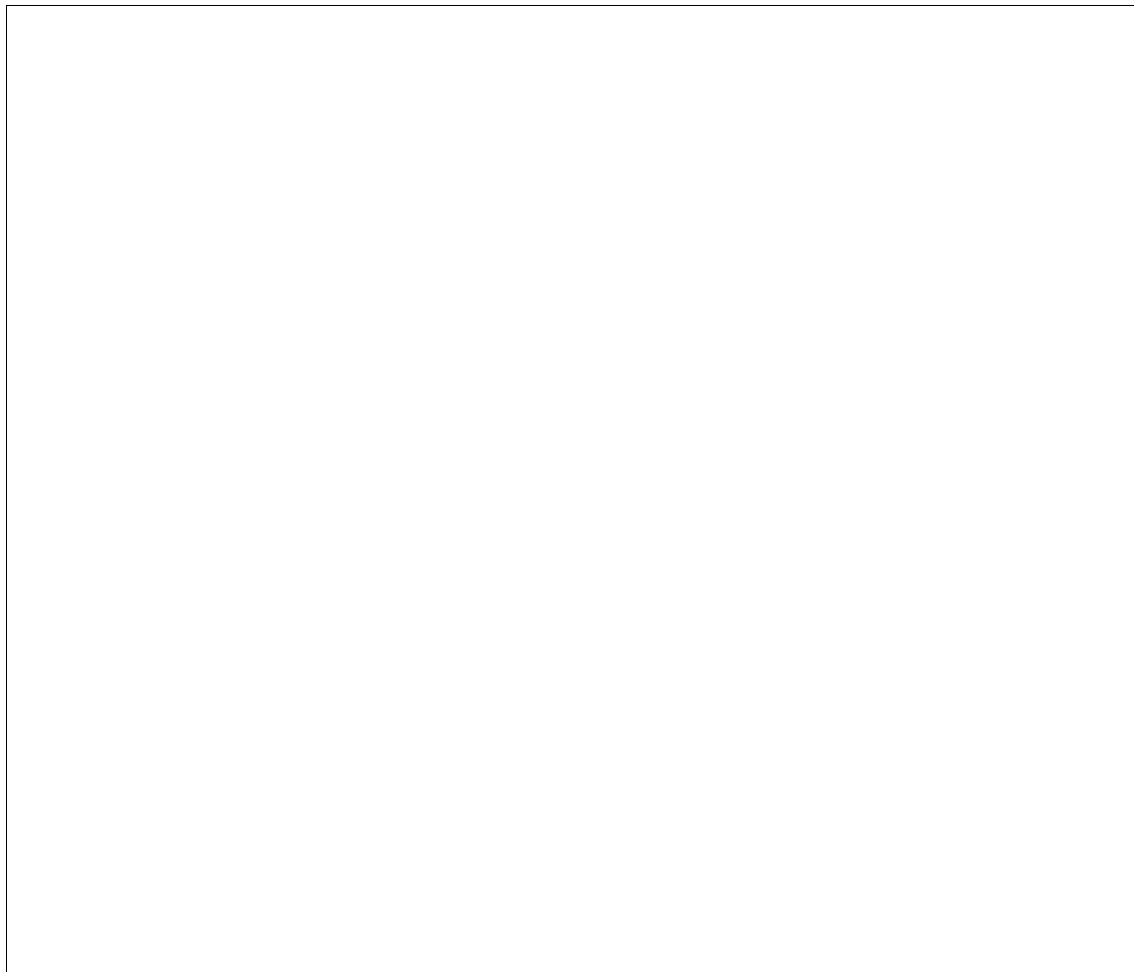
(Image source: <http://www.microbehunter.com/root-of-a-monocot/>)

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

Label	Structure	Tissue/specialized cells
A		
B		
C		
D		
E		
F		

[six marks]

1.5. Draw and label a schematic transverse section of a dicot root.



[five marks]

1.6. Name ONE major difference between dicot and monocot roots.

[one mark]

[Total: Twenty two marks]

2. This question is about Taxonomy.

2.1. The species in **Figures 3, 4 and 5** below, belong to the same Kingdom. Identify the Kingdom and give TWO characteristic features of species belonging to this Kingdom.

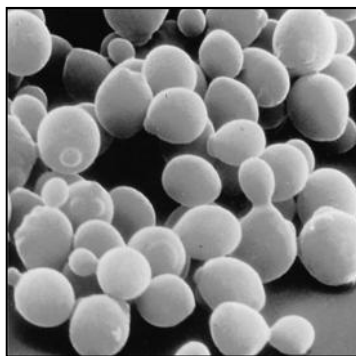


Figure 3



Figure 4



Figure 5



[two marks]

2.2. The species in **Figures 6 and 7** belong to the same Phylum.

2.2.i. Identify the Phylum and give ONE characteristic feature of this group.

[two marks]

2.2.ii. Describe TWO distinguishing features visible in each of the photographs below and use them to identify the Class of each organism.

 <p style="text-align: center;">Figure 6</p>	<p>Class:</p> <hr/> <p>Diagnostic Features:</p> <p>(i)</p> <p>(ii)</p>
 <p style="text-align: center;">Figure 7</p>	<p>Class:</p> <hr/> <p>Diagnostic Features:</p> <p>(i)</p> <p>(ii)</p>

[five marks]

2.3 Label and annotate TWO structural distinguishing features for the animal in **Figure 8** below. Identify the Phylum and Class of this organism.

Phylum: _____

Class: _____



Figure 8

[three marks]
 [Total: Twelve marks]

3. This question concerns food tests.

3.1. Describe the methods used to test for the presence of the following biochemicals in food samples. Give details of the reagents and the expected observations associated with each test.

3.1.i. Reducing sugars _____

[two marks]

3.1.ii. Non-reducing sugars _____

[two marks]

3.1.iii. Proteins _____

[two marks]

3.1.iv. Lipids _____

[two marks]

3.1.v. Starch

[two marks]

3.2. **Table 1** shows the results of food tests carried out on four unknown samples A, B, C and D. The presence of each biochemical was tested for and a scale was used in the compilation of the results to allow for better comparison. A high concentration of a biochemical was denoted by + + + + + and complete absence was denoted by - - - - -. The food samples used in this experiment were potato starch, soya flour, lemon juice and egg yolk.

Table 1: Food Tests Results				
	Unknown Sample			
Biochemicals	A	B	C	D
Reducing sugars	- - - - -	+ + + + +	- - - - -	+ +
Non-reducing sugars	- - - - -	+ + + + +	- - - - -	- - - - -
Starch	- - - - -	- - - - -	+ + + + +	- - - - -
Lipids	+ +	+ + +	- - - - -	- - - - -
Proteins	+ + + + +	- - - - -	+ +	+ + + + +

Use the results presented in **Table 1** to identify the unknown samples. Explain your conclusions in terms of the biochemical composition of each food item.

[six marks]
 [Total: Sixteen marks]

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UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2015

SUBJECT:	BIOLOGY
PAPER NUMBER:	IV – <i>Practical</i>
DATE:	5 th June 2015
TIME:	1 hr 30 min

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

DO NOT WRITE ABOVE THIS LINE

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

[four marks]

1.9. List TWO sources of error in your investigation.

[two marks]

1.10. Briefly describe a modification you would do to your experimental set-up to give more reliable results.

[one mark]

[Total: Forty marks]

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