

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA

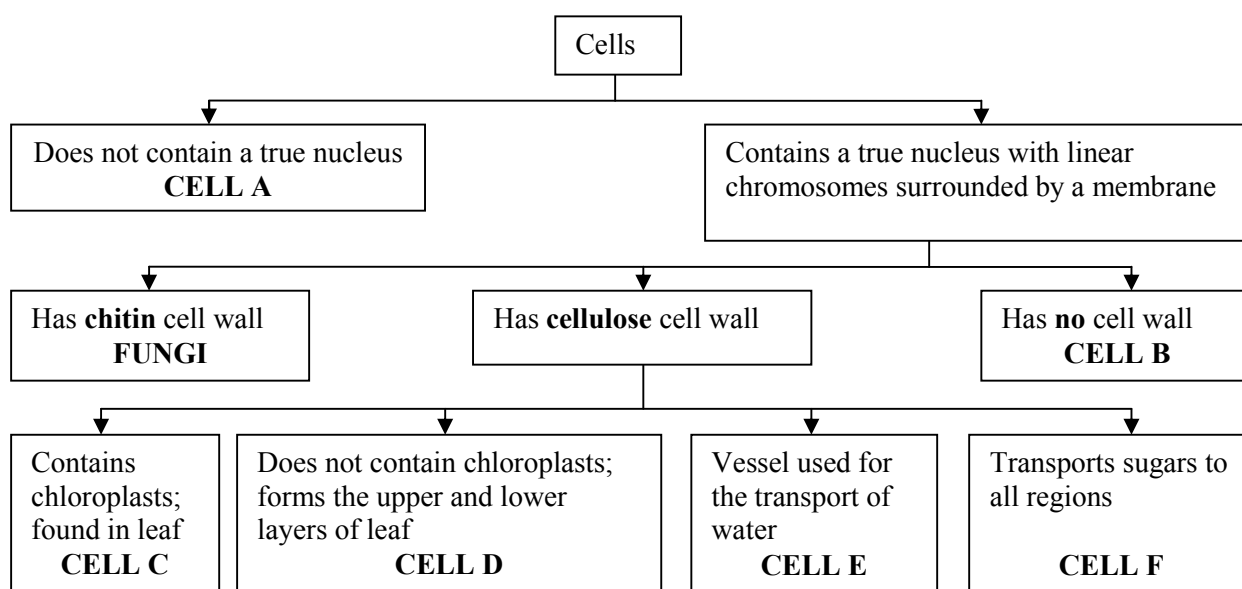
SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2015 SESSION

SUBJECT: **Biology**
 PAPER NUMBER: **I**
 DATE: **18th May 2015**
 TIME: **4:00 p.m. to 6:00 p.m.**

ANSWER ALL QUESTIONS IN THIS PAPER IN THE SPACES PROVIDED.

1. The flow diagram below shows different types of cells.



a. Name cell **C** and cell **F**.

C _____

F _____
(2 marks)

b. Other than the features in the flow diagram, list ONE structural similarity and ONE structural difference between cell **A** and cell **D**.

Similarity: _____

Difference: _____
(1, 1 mark)

c. List ONE structural feature of cell **E**.

(1 mark)

d. Red blood cells are an example of cell **B**. However these cells do not have a nucleus and mitochondria.

i) Explain how the feature of having no nucleus helps in the role of these cells.

(2 marks)

ii) Give the function of a mitochondrion.

(1 mark)

iii) Stem cells in the bone marrow produce red blood cells. Name the cell division by the stem cell to make red blood cells.

(1 mark)

(Total: 9 marks)

2. When the leaves of *Mimosa pudica* are touched, they close quickly. The movement occurs only in small specific organs called pulvini (singular pulvinus).

a. Define the term *organ*.

(2 marks)

- b. The diagrams below show two pulvini. They show a row of cells on the top of the organ and a row of cells at the bottom.

Diagram 1 shows the pulvinus in the normal state. All the cells are roughly equal in length keeping the leaflet horizontal.

Diagram 2 shows the pulvinus after a stimulus. The cells on the top lose water and shrink. Those at the bottom swell and lengthen. This forces the pulvinus to bend.

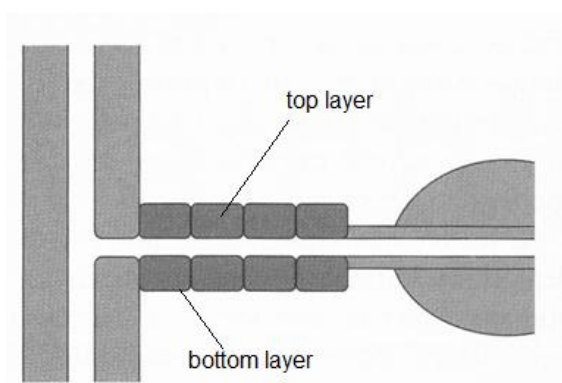


Diagram 1: Pulvinus in the normal state

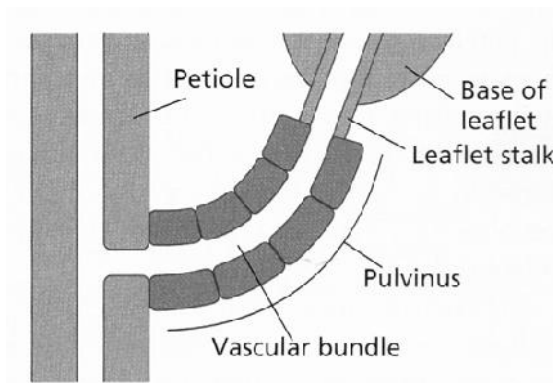


Diagram 2: Pulvinus after stimulation

- i) Name the process by which water moves in and out of cells in the pulvinus.

(1 mark)

- ii) Which layer of cells in the stimulated pulvinus is turgid? Give a biological reason for your answer.

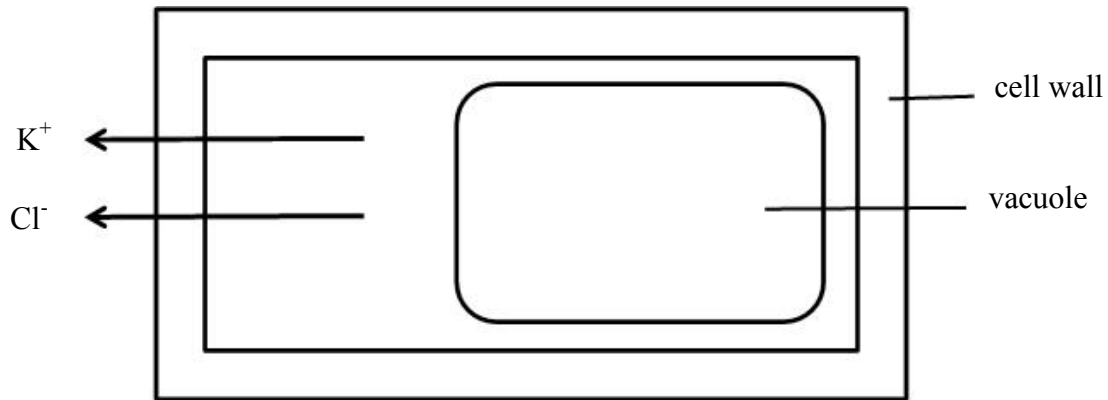
(1, 1 mark)

- c. In the normal state, the cells of the pulvinus keep a higher concentration of potassium (K^+) and chloride (Cl^-) ions in their cytoplasm than outside by means of active transport. When the leaf is touched the ions move out of the cell passively.

- i) Define *active transport*.

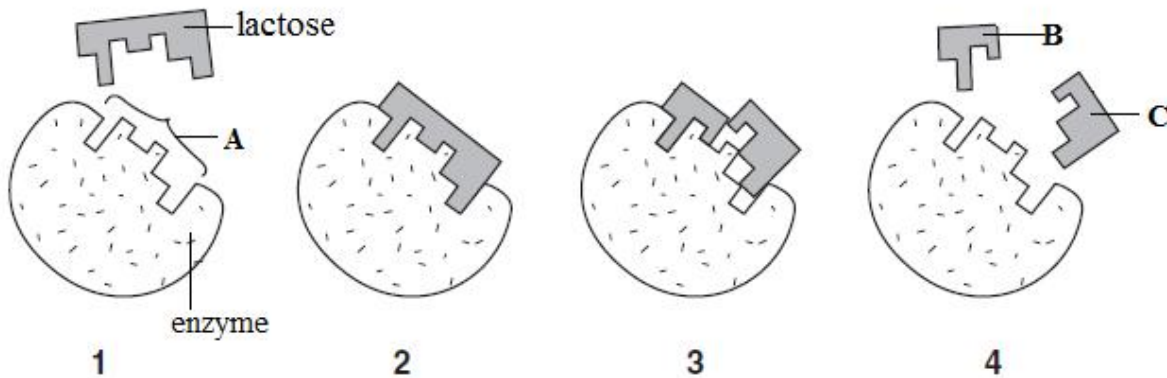
(2 marks)

- ii) In the diagram provided indicate the direction of movement of water after the K^+ and Cl^- ions move out of the cell. Give a reason for your answer.



(1, 2 marks)
(Total: 10 marks)

3. The diagram below shows the enzyme reaction involved in the breakdown of lactose.



- a. Lactose is a *disaccharide*. Explain.

(1 mark)

- b. Name the part of the enzyme labelled **A**.

(1 mark)

- c. Name the products **B** and **C** of the above reaction.

(1, 1 mark)

- d. Explain why only a small amount of enzyme is needed to catalyse a reaction involving many molecules.

(1 mark)

- e. Explain how a rise in temperature may increase the rate of an enzyme-controlled reaction.

(2 marks)

- f. At high temperatures enzymes are denatured. Explain what happens when an enzyme is denatured.

(2 marks)

(Total: 9 marks)

4. Below are details of two plant species discovered and observed in the last years.

	Species A	Species B
Scientific name	<i>Rinorea niccolifera</i>	<i>Polypodium vulgare</i> subsp. <i>melitense</i>
Characteristics	Form seeds; have flowers with five petals	Has fronds and forms spores
Special Properties	Accumulates the metal nickel in its seeds	Grows in a rocky, arid (dry) and warm environment

- a. i) Name the group/division of which species B is a member.

(1 mark)

- ii) Species B produces large numbers of spores. Give the importance of this feature.

(1 mark)

-
- iii) One surprising property of species B is that it grows in a rocky and arid (dry) environment. Explain why this is surprising.
-

(2 marks)

- b. i) Species A is an angiosperm. Is the plant monocotyledonous or dicotyledonous? List ONE reason for your answer.
-

(1, 1 mark)

- ii) Give TWO other characteristics of the group given in b(i).
-

(2 marks)

- c. Species A accumulate nickel in high quantities in the stem and leaves. Very few plant species are nickel accumulators. In these plants the chemical does not poison the plants. High concentrations of nickel in other plants cause retarded shoot and root growth.

- i) Name ONE element needed by plants for the production of proteins.
-

(1 mark)

- ii) Nickel is an important trace element in leguminous plants for the growth of root nodules and nitrogen fixation. Describe the role of root nodules in nitrogen fixation.
-

(2 marks)

(Total: 11 marks)

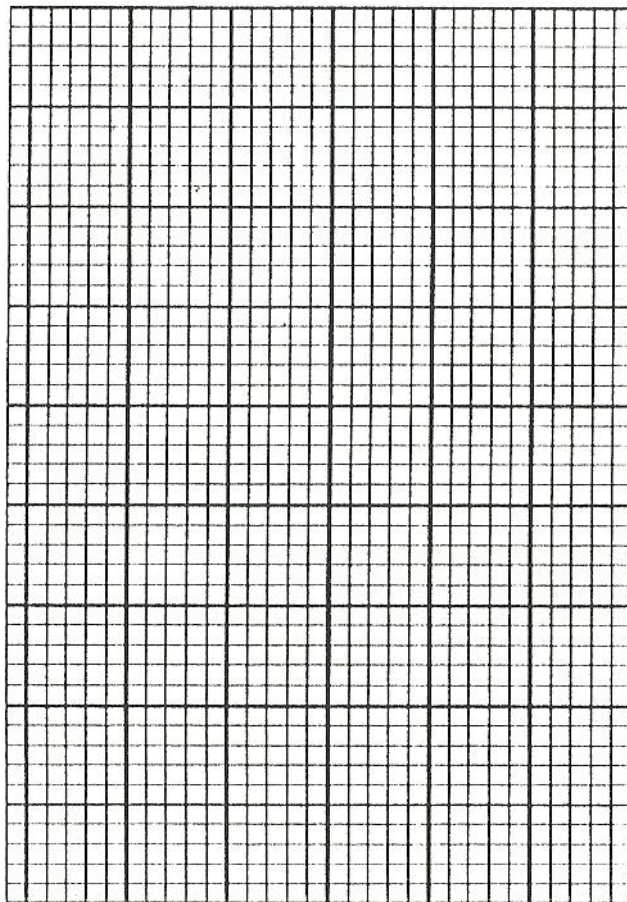
5. A student performed an experiment to investigate the effect of varying light intensity on the rate of photosynthesis.
 The student placed a piece of pond weed under water in a boiling tube and shone light on it. To determine the rate of photosynthesis, the student counted the number of bubbles released from the pondweed in one minute.
 The table below shows the results obtained.

Light Intensity/ Arbitrary units	No. of bubbles released in 1 minute
2.0	7
4.0	13
6.0	21
8.0	24
10.0	30

- a. Name the gas present in the bubbles released.

(1 mark)

- b. i) Draw a graph to show how the rate of photosynthesis varies with light intensity.



(5 marks)

-
- ii) Use the graph to describe how light intensity affects the rate of photosynthesis.
-

(1 mark)

- c. The student repeated the experiment to determine how different colours of light affect the rate of photosynthesis. The results are shown in the table below.

Light colour	No. of bubbles released in 1 minute
Red	15
Blue	16
Green	5

- i) Which colour gives the lowest rate of photosynthesis? Give a reason for your answer.
-
-

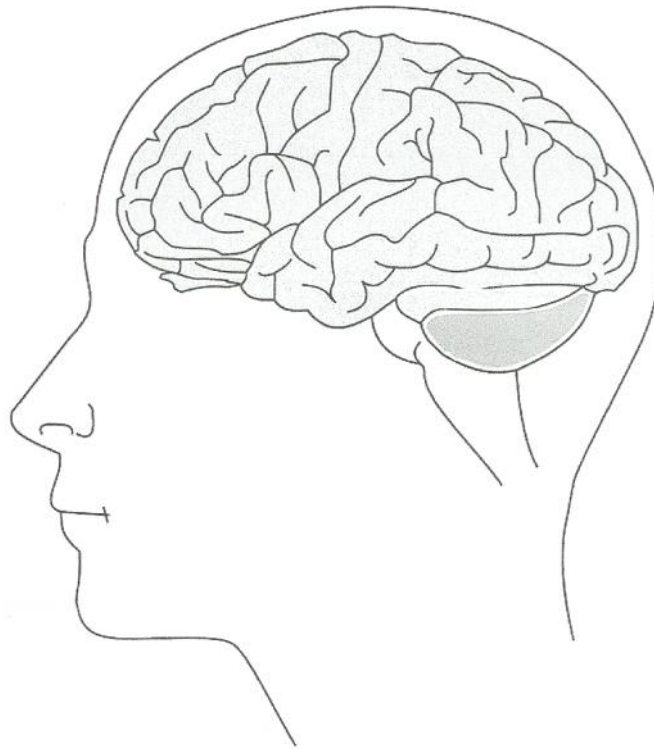
(1, 1 mark)

- ii) The level of carbon dioxide (CO₂) in the water was kept at 6.0 units throughout the experiment. What happens to the number of bubbles released in 1 minute if the level of CO₂ is increased to 12.0 units? Give a reason for your answer.
-
-

(1, 1 mark)

(Total: 11 marks)

6. The following diagram shows the human brain.



a. On the diagram label the cerebellum and the medulla oblongata. (2 marks)

b. Name the structure that together with the brain forms the central nervous system.

(1 mark)

c. Give ONE function of the cerebrum.

(1 mark)

d. The cortex of the cerebrum is folded into wrinkles and furrows. Explain the importance of these folds.

(2 marks)

e. The figure shows a student holding a book.



Mark with a tick (✓) the area in the cerebrum responsible for the different processes involved in holding a book.

	Sensory area	Association area	Motor area
Bending of muscles in arms to hold the book			
Receives messages from the eyes to see the book			
Area that links the image of the book with the response to hold it			

(3 marks)

(Total: 9 marks)

7. The amount of carbon dioxide (CO₂) in the atmosphere has been rising at an increasing rate for the past 200 years.

a. Explain how each of the changes below can help to slow down the rate of increase of carbon dioxide.

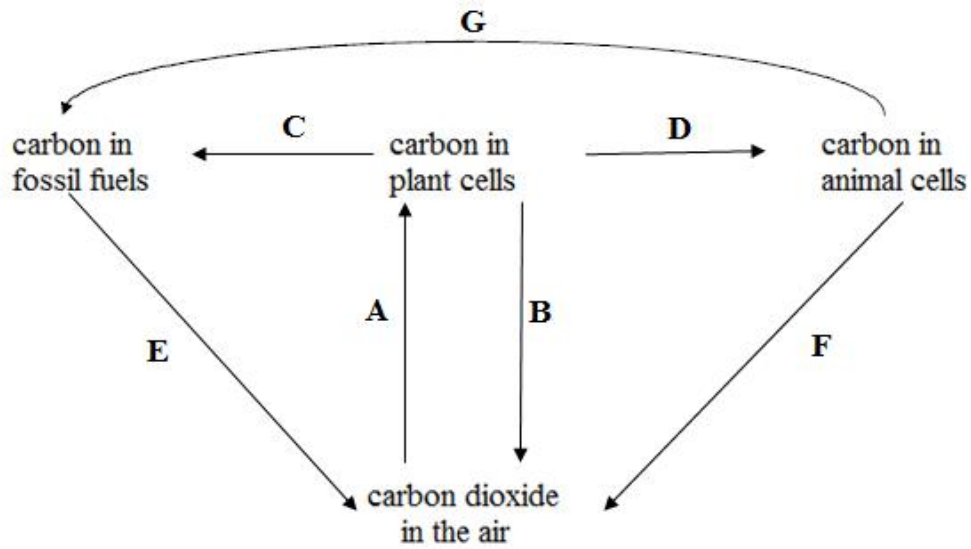
i) Use solar power to generate electricity.

(2 marks)

ii) Stop cutting down trees to clear the land.

(2 marks)

b. The diagram below shows part of the carbon cycle.



Name the arrows that represent:

i) combustion _____

ii) respiration _____

(1, 2 marks)

c. Name the process represented by arrow **D**.

(1 mark)

d. Carbon monoxide is a pollutant gas released from industrial and domestic waste.

i) Carbon monoxide is a greenhouse gas. Explain.

(1 mark)

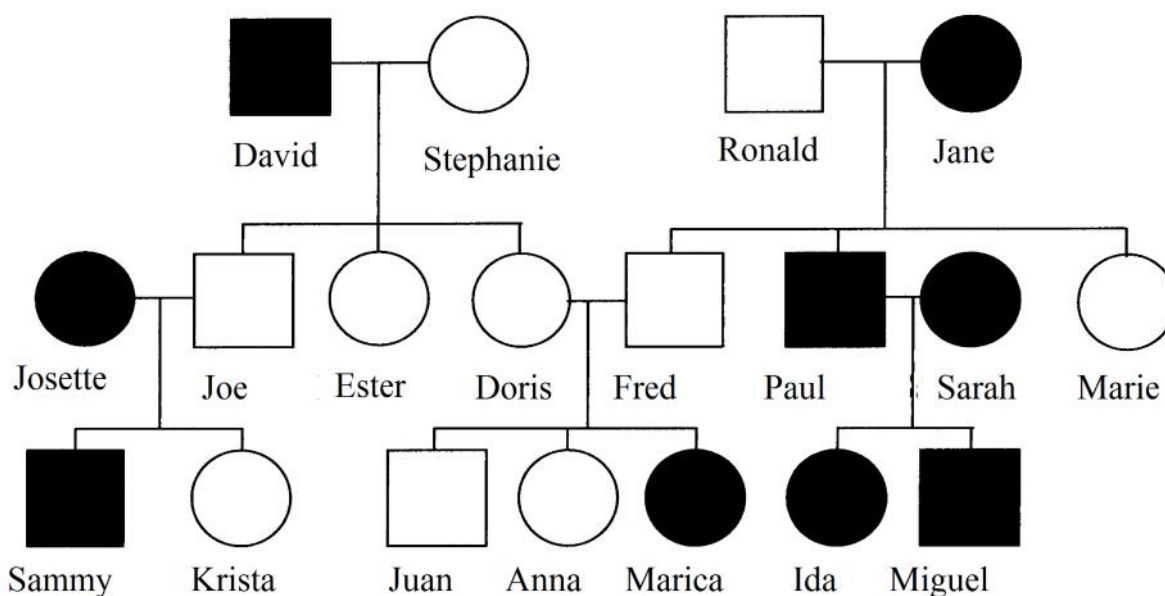
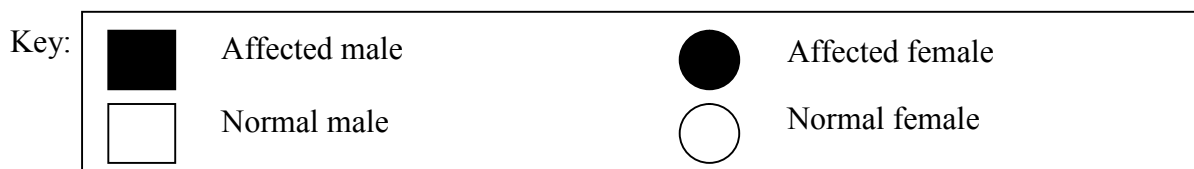
ii) Explain how carbon monoxide gas can interfere with the normal body's functioning.

(1 mark)

(Total: 10 marks)

8. Long QT syndrome is a heart rhythm disorder. It is a rare genetic condition that arises from mutations of about nine genes. It was first clearly described in 1957 by doctors A. Jervell and F. Lange-Nielsen. Long QT syndrome appears to be a common cause of sudden and unexplained death in children and young adults. It is more common than previously thought, affecting about 1 in 5000 people.

The diagram below shows a family's pedigree.



- a. Define the term *mutations*.

(1 mark)

- b. Give ONE piece of evidence from the diagram which proves that inherited long QT syndrome is caused by a recessive allele.

(2 marks)

- c. Use **H** for normal and **h** for long QT syndrome to state the genotypes of:

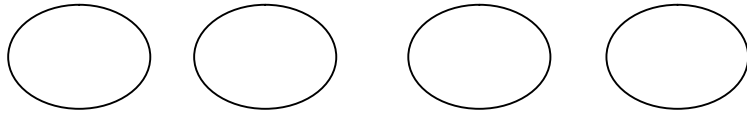
- i) David: _____ ii) Joe: _____

(2 marks)

- d. Use a genetic diagram to determine the probability that Miguel and Krista's child will be affected.

Parents' genotype _____

Gamete's genotype



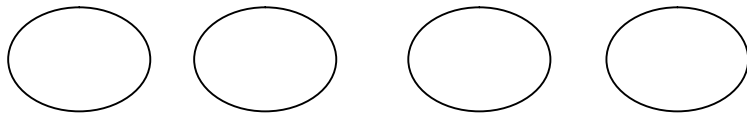
Offspring genotype _____

Probability of child being affected: _____ (4 marks)

- e. Marica is affected with long QT syndrome, even though both her parents are normal. Use a genetic diagram to explain how this is possible.

Parents' genotype _____

Gamete's genotype



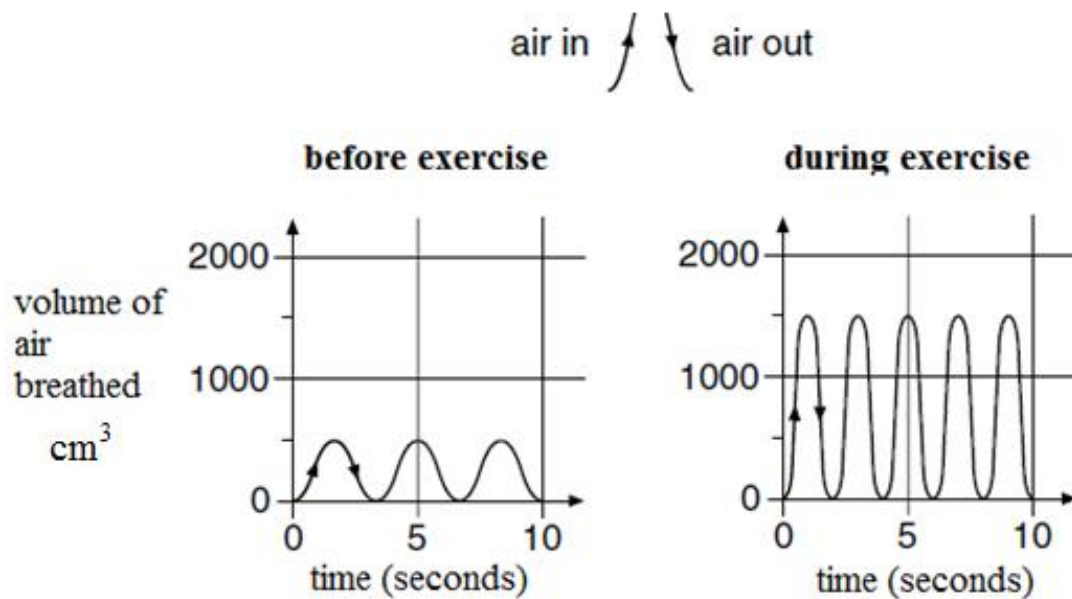
Offspring genotype _____

Offspring phenotype _____ (4 marks)
(Total: 13 marks)

9. Stephania measured the volume of air breathed in and out of her lungs while she was training on a treadmill, as shown in the picture below.



The graphs below represent the volume of air Stephania breathes in and out with each breath before and during exercise.



- a. During exercise, Stephania breathed more air in and out of her lungs than before exercise. How much MORE air did she breathe in with each breath during exercise?

(1 mark)

- b. Explain why Stephania needed to breathe in more air during exercise.

(1 mark)

c. As Stephania exercised, the volume of air breathed in and out increased. Name ONE other way how Stephania's breathing changed during exercise.

(1 mark)

d. Explain how the graphs show the change you mentioned in (9c).

(1 mark)

e. Explain how the breathing system is adapted to provide the lungs with clean air.

(2 marks)

f. Describe the role of the rib cage during breathing in.

(2 marks)

g. Cigarette smoking affects the respiratory system, making it less efficient. Bronchioles lose elasticity and are unable to withstand the pressure in the alveoli causing them to rupture and leading to smoking-induced emphysema. Describe the effects of this condition on a smoker's health.

(2 marks)
(Total: 10 marks)

Please turn the page.

10. Give TWO reasons for each of the following statements.

a. In sloping fields, farmers use strip cropping as an effective method of producing crops.

(2 marks)

b. MEPA officials check the lead concentration in Maltese farmed soil.

(2 marks)

c. No hunting and trapping is allowed at the Simar nature reserve.

(2 marks)

d. In the last decade newly produced refrigerators (fridges) use hydrocarbons (HC) instead of chlorofluorocarbons (CFC) for cooling.

(2 marks)
(Total: 8 marks)

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UNIVERSITY OF MALTA, MSIDA

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2015 SESSION

SUBJECT:	Biology
PAPER NUMBER:	IIA
DATE:	19 th May 2015
TIME:	4:00 p.m. to 6:00 p.m.

Write your answers on the booklet provided. Write down the number of the questions you answer on the front page of your answer booklet.

Please note that for question 2 of this paper you need the graph paper in the booklet.

Section A: Answer ALL questions in this section. This section carries 25 marks.

1. Read the following passage and then answer the questions that follow.

The *Pisonia* is a tropical tree. The tree provides the favourite nesting site for the Seychelles Warbler, a bird saved from extinction by transporting breeding pairs to an island with the trees.

Manta rays, huge ‘winged’ filter-feeding fish are more numerous around coasts where *Pisonia* trees grow than where the trees have been removed and coconut palms planted in their place. This is because few animals perch or nest in coconut trees. A huge range of animals use *Pisonia* trees however, and when their excretory products fall to the ground beneath them, it provides nutrients for the tree and enriches the rain that runs off into the sea. This increase the number of plankton upon which manta rays feed.

But *Pisonia* has a darker side. When the flowers are fertilised, the branched fruiting structures they produce bear up to 200 seeds, which are encased in seed pods that secrete an exceptionally sticky substance. This means that the pods stick to the feathers of birds that brush against them. Birds that can still fly despite their sticky passengers distribute the plant to new locations. Sometimes, however, the pods prevent birds from flying and they die. This will increase the chance of survival for the germinating seeds.

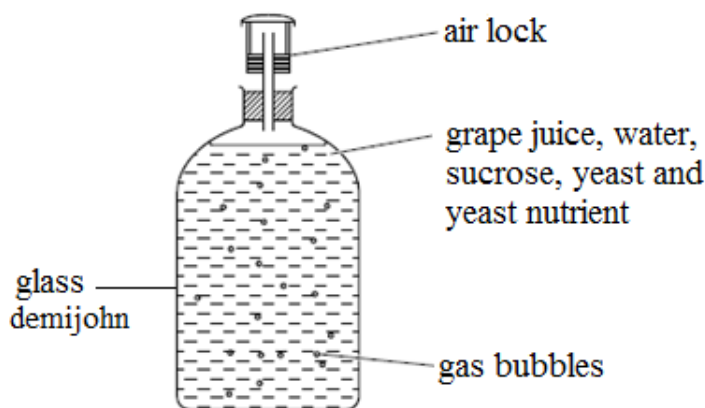
In a study of one species of Tropicbird, 23% of adult deaths were traced to intolerable burdens of *Pisonia* seed pods. This is why the common name of one *Pisonia* species is ‘Australian catchbird tree’ and why careful management of the trees in world heritage sites is being undertaken to minimise the damage caused to native birds.

(Adapted from Sheffield L., *Killer tree*, Biological Sciences Review Vol. 27, No. 2, Nov 2014)

- a. Define the term *extinction*. (1 mark)
- b.
 - i) Describe the link between the number of *Pisonia* trees and the increase in plankton in the nearby sea. (2 marks)
 - ii) Sketch a pyramid of numbers to show the relationship between a *Pisonia* tree, Seychelles warblers and plankton. (3 marks)
- c. Give ONE piece of evidence to show that the seeds of *Pisonia* are adapted to be dispersed by animals. (1 mark)

- d. State ONE reason why the inability to fly may cause a bird to die. (2 marks)
 - e. Explain why the death of a bird ‘will increase the chance of survival for germinating seeds’. (2 marks)
 - f. The common name of one *Pisonia* species is ‘Australian catchbird tree’. Give ONE advantage of using scientific names instead of common names. (2 marks)
- (Total: 13 marks)**

2. After grape harvesting, it is traditional of Maltese farmers to make home-made wine. After crushing the grapes, adding sucrose, yeast and yeast nutrient, grape juice is filtered and stored in glass demijohns. The table shows the first 20 days of the wine making process.



Time (days)	Concentration of sucrose/grams per dm ³	Concentration of alcohol in arbitrary units	Number of gas bubbles/ hour
2	325	0	100
4	225	0	50
6	150	100	30
14	100	200	10
20	75	400	5

- a. On the graph paper provided (use the 2mm grid scale), draw **TWO** line graphs on the same axes, to show the relationship between concentration of sucrose and alcohol with time. Join the points of each graph with straight lines. (6 marks)
 - b. State the concentration of sucrose on day 10. (1 mark)
 - c. Describe the relationship between the concentration of alcohol and the number of gas bubbles in the demijohn. (2 marks)
 - d. When the concentration of alcohol reaches 800 arbitrary units, no more gas bubbles are produced. Explain why the alcohol content cannot increase further. (1 mark)
 - e. Besides wine-making, yeast is economically important to humans for the production of other food sources. Describe the role of yeast in the production of bread and explain what happens to the products of this process. (2 marks)
- (Total: 12 marks)**

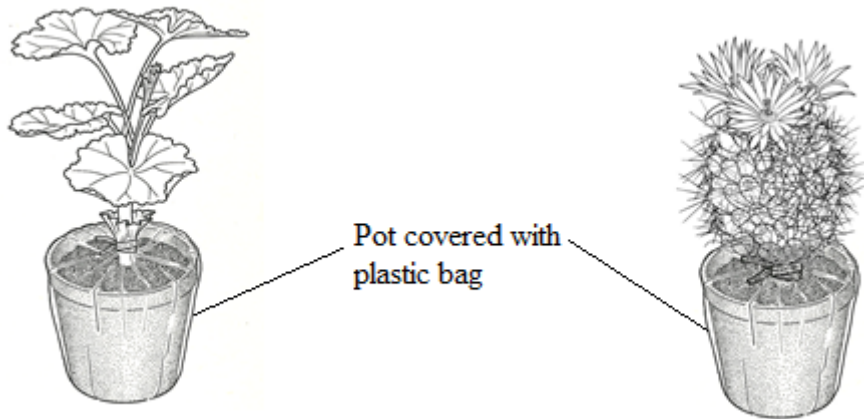
Section B: Answer any THREE questions from this section.

3a. In a study on contractile vacuole function in the protist *Chlamydomonas*, the following results were obtained.

	Observed Vacuole	Results observed
Normal protist	Normal sized contractile vacuole	Cell growth in hypotonic (dilute) solution
Mutated protist	Many small contractile vacuoles	No cell growth in hypotonic (dilute) solution

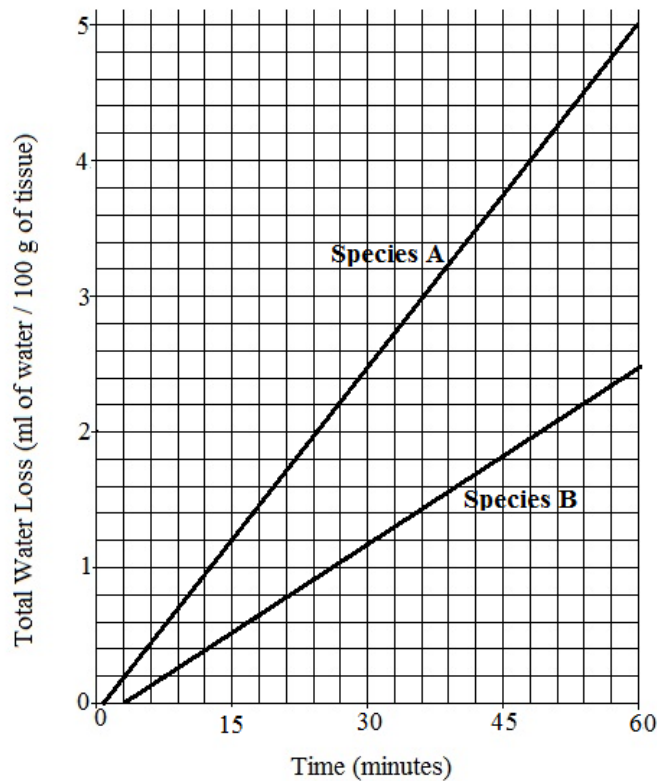
- i) *Chlamydomonas* is a plant like protist. Give TWO characteristic features of a plant like protist. (2 marks)
 - ii) Explain why, in the investigation, protists were put in a hypotonic (dilute) solution. (2 marks)
 - iii) The mutated protist had abnormal proteins lining the contractile vacuoles. These stopped the contractile vacuoles from fusing with the cell membrane. Explain the importance of the contractile vacuole fusion with the cell membrane in relation to the role of these vacuoles. (3 marks)
 - iv) One feature noted in plant like protists is their lack of transport system. Provide ONE biological reason for this observation. (2 marks)
- b. Mammalian kidneys contain structures called nephrons. These filter and remove nitrogenous waste, excess water and salts from the blood.
- i) Name the nitrogenous waste compound produced by the liver. (1 mark)
 - ii) This nitrogenous waste compound is produced in large amounts on the breakdown of a macronutrient. Name this macronutrient. (1 mark)
 - iii) Describe the passage of urine from when it leaves the kidneys until this fluid is removed from the mammalian body. (3 marks)
- c. The mammalian kidney receives the nitrogenous waste in blood from the renal artery.
- i) List ONE structural difference between an artery and a vein. (1 mark)
 - ii) Blood carries oxygen from the lungs to all the cells of the body. Explain how blood carries oxygen. (2 marks)
 - iii) Blood has difficulty returning to the heart from the legs. Give TWO ways how blood is helped to get back to the heart. (2 marks)
- d. Vitamin D can be produced by the skin on exposure to sunlight. It is processed by the liver and activated in the kidneys.
- i) Name ONE other source of Vitamin D. (1 mark)
 - ii) State the importance of this vitamin in the human body. (1 mark)
- e. Kidney failure can lead to high blood pressure that affects the health of blood vessels and the heart.
- i) Explain how a high blood pressure affects the blood vessels and heart. (2 marks)
 - ii) Name and explain ONE lifestyle that may lead to high blood pressure. (2 marks)
- (Total: 25 marks)**

4. Students carried out experiments to investigate the loss in mass of two different plant species. They enclosed each pot in a plastic bag and measured the mass of each plant at regular intervals during one hour.

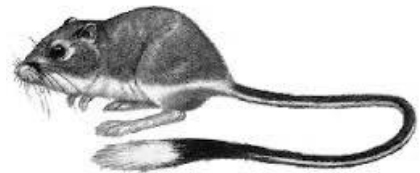


- a. Students assumed that the loss in mass is entirely the result of transpiration of water from the shoot. Name ONE other process in the plant that is likely to cause a loss in mass. (1 mark)
- b. Explain the importance of enclosing the plant pot in a plastic bag. (1 mark)
- c. The experiment was carried out with both plants first in the sunlight, then in the shade. State the difference in the transpiration rates observed. (2 marks)
- d. Apart from light intensity, name TWO other environmental factors that affect the rate of transpiration. Sketch graphs to show their relationships. (4 marks)
- e. State TWO reasons why transpiration is an important process in plants. (2 marks)

- f. Students plotted a graph to show the total water loss per 100g of tissue for both plant species in 1 hour. The graph is shown below.



- i) How many ml of water are lost by species B in 30 minutes. (1 mark)
 - ii) Calculate the rate of transpiration for species A and species B between 30 and 45 minutes. (2 marks)
- g. In the last decade, scientists produced genetically engineered plants that lose less water from transpiration.
- i) Define *recombinant DNA*. (1 mark)
 - ii) Describe the role of vectors. (1 mark)
 - iii) One way of cloning plants is by tissue culture. Explain why the agar jelly on which the tissue culture is placed is sterile. (2 marks)
 - iv) Auxins are added to the agar. Explain. (2 marks)
- h. The kangaroo rat lives in desert regions. It needs to minimize water loss. List TWO behavioural adaptations it can adopt to limit water loss. (2 marks)



- i. The human skin reacts to overheating using different mechanisms. Name TWO mechanisms and explain how they contribute to keep the body temperature constant. (4 marks)

(Total: 25 marks)

5. The small hive beetle *Aethina tumida* is an indigenous insect of the sun-Saharan desert. It has lately been observed in Southern Italy and is attacking the local honey bee hives. The small hive beetle is described as a pest, a parasite and a scavenger.
- a.
 - i) List the phylum of the beetle and give TWO characteristic features of this phylum. (1, 2 marks)
 - ii) Define the term *scavenger*. (2 marks)
 - b. Both the honey bee and the small hive beetle exhibit complete metamorphosis. Describe each stage of this process. You may use a diagram to help you in your answer. (6 marks)
 - c. The small hive beetle is attracted to the bee hive by the scent of the adult bee workers, freshly collected pollen and honey. The beetle harms the hive through its faeces. The faeces contain the yeast *Kodamaea ohmeri* which ferments the honey. On infestation the honey bees leave the hive and colony.
 - i) Describe a pollen grain. (1 mark)
 - ii) List the genus name of the yeast. (1 mark)
 - iii) Describe how yeast cells reproduce asexually. (3 marks)
 - iv) Insect-pollinated flowers have different features to ensure attraction and pollination by bees. Give TWO features of an insect pollinated flower. (2 marks)
 - d. Another parasite on honey bees is the tracheal mite. The mite, an arachnid, lives in the trachea of the honey bee. The young mites pierce the host's trachea and feed on the bee's fluids.
 - i) Give ONE difference between an insect and an arachnid. (2 marks)
 - ii) State the role of the tracheal system in insects. (2 marks)
 - iii) Spiracles are found at the outer tracheal end. Give the function of spiracles. (1 mark)
 - iv) Give TWO ways how this parasitism affects the honey bee. (2 marks)

(Total: 25 marks)
6. The following statements are incorrect. Write down the correct statement and give an explanation of why the statement below is incorrect.
- a. All viruses and bacteria cause disease. (1, 4 marks)
 - b. Bacteria are non-cellular microbes with genetic material surrounded by a protein coat. (1, 2 marks)
 - c. In a food chain, 90% of the energy is passed from one trophic level to another. (1, 4 marks)
 - d. Bryophytes are plants that produce seeds in cones. (1, 3 marks)
 - e. The cow is a ruminant and has mutualistic bacteria in the ceacum. (1, 4 marks)
 - f. Birds and reptiles are ectothermic. (1, 2 marks)
- (Total: 25 marks)**

7. The potato tuber is susceptible to several bacterial or fungal infections. Common scab is a bacterial disease which develops in acidic and dry soils while black scurf is a fungal infection.
- a. Specialised structures such as tubers are a form of vegetative propagation. Give ONE advantage and ONE disadvantage of vegetative propagation over seed formation. (1, 1 mark)
- b. i) Explain how a farmer can make the soil less acidic to reduce the growth of the common scab. (1 mark)
ii) An acidic soil reduces the uptake of mineral ions from the soil. Describe the process of uptake of mineral ions from the soil. (2 marks)
- c. List ONE characteristic of soil that allows the growth of the fungus giving rise to black scurf. Give a reason for your answer. (1, 1 mark)
- d. Describe the beneficial aspect of the following on soil:
i) earthworms; (3 marks)
ii) humus; (3 marks)
iii) air spaces between soil particles. (2 marks)
- e. A farmer has two adjacent fields A and B. Below is his description of the soil found in these fields.

Field A: The soil has a high water-holding capacity. When the soil dries out it becomes stiff and difficult to work.
Field B: The soil is very often dry, nutrient deficient and fast-draining.

- i) Name the type of soil found in field A and field B. (1, 1 mark)
ii) Explain why plants in field A die when the field becomes water logged. (3 marks)
iii) Describe ONE organic method of how the farmer may increase the nutrients in field B. (2 marks)
- f. Il- Magħluq, one of the few saline marshlands in Malta, is surrounded by agricultural land. One threat to the local flora and fauna of this marshland is eutrophication. Explain. (3 marks)
(Total: 25 marks)

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA**SECONDARY EDUCATION CERTIFICATE LEVEL****MAY 2015 SESSION**

SUBJECT:	Biology
PAPER NUMBER:	IIB
DATE:	19 th May 2015
TIME:	4:00 p.m. to 6:00 p.m.

Write your answers on the booklet provided. Write down the number of the questions you answer, on the front page of your answer booklet.

Please note that for question 3 of this paper you need the graph paper in the booklet.

Answer any FOUR questions.

- 1a. Specialised structures such as tubers are a form of vegetative propagation.
- i) State the type of reproduction involved in vegetative propagation. (1 mark)
 - ii) Give ONE advantage and ONE disadvantage of the type of reproduction mentioned in (a i). (2 marks)
- b. The potato tuber is susceptible to several bacterial or fungal infections. Common scab is a bacterial disease which develops in acidic and dry soils while black scurf is a fungal infection.
- i) Explain why tubers are defined as storage organs. (2 marks)
 - ii) Describe how a farmer can make the soil less acidic to reduce the growth of the common scab. (2 marks)
- c.
- i) Draw a well-labelled diagram of the female reproductive system. Label the following structures: uterus, fallopian tubes, ovary and cervix. (6 marks)
 - ii) Name the part of the reproductive system where fertilisation occurs. (1 mark)
 - iii) Describe how the fallopian tubes aid the movement of the ovum. (2 marks)
- d. Endometriosis is a human abdominal condition when the inner lining of the uterus, the endometrium, moves up the uterus and finds its way to the abdomen cavity. Normally the endometrium breaks up and passes through the cervix and out of the body during menstruation.
- i) Name ONE other organ found in the abdomen. (1 mark)
 - ii) Name the muscle which separates the thorax from the abdomen and give its function. (2 marks)
 - iii) Give the range of days when menstruation occurs in the menstrual cycle. (1 mark)
 - iv) Name the hormone that stimulates the repair of the inner lining after menstruation and give its site of production. (1, 1 mark)
- e. Describe the role of the placenta during pregnancy. (3 marks)

(Total: 25 marks)

2. The *Pisonia* is a tropical tree. The tree provides the favourite nesting site for the Seychelles warbler, a bird species that was saved from extinction by transporting breeding pairs to an island with the trees.
- a. List TWO characteristics that show that the *Pisonia* belongs to the plant kingdom. (2 marks)
- b. Define the term *extinction*. (2 marks)

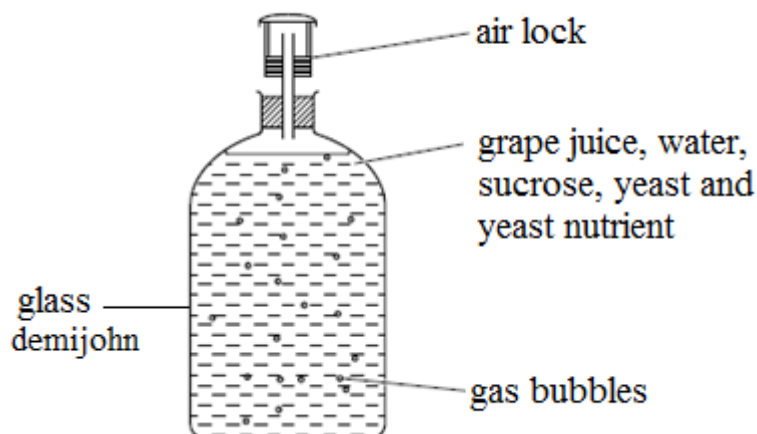
Manta rays are fish with very large fins that look like wings. They are more numerous around the coasts where *Pisonia* trees grow than where the trees have been removed and coconut trees planted in their place. This is because few animals perch or nest in coconut trees. A huge range of animals use *Pisonia* trees however, and where their excretory products fall to the ground beneath them, it provides nutrients for the tree and enriches the rain that runs off into the sea. This increases the numbers of plankton upon which manta rays feed.

- c. i) Define the term *excretory products*. (2 marks)
ii) Excretory products are rich in nitrogen. With reference to the nitrogen cycle describe how the nitrogen in excretory products is made available to plants. (4 marks)
iii) Draw a pyramid of numbers to show the relationship between plankton and manta rays. (2 marks)

But *Pisonia* has a darker side. When the flowers are fertilised, the branched fruiting structures they produce bear up to 200 seeds, which are encased in seed pods that secrete an exceptionally sticky substance. This means that the pods stick to the feathers of birds that brush against them. Birds that can fly despite the sticky pods distribute the plants to new locations. Sometimes, however, the pods prevent birds from flying and they die. This will increase the chance of survival for the germinating seeds.

- d. Describe the process involved in:
i) pollination;
ii) fertilisation of flowers.
In your answer include the terms: anther, style, stigma, pollen, pollen tube, male nucleus, egg cell. (3, 4 marks)
- e. Give ONE piece of evidence that the seeds of *Pisonia* are adapted to be dispersed by animals. (2 marks)
- f. List ONE reason why a bird may die if it cannot fly. (2 marks)
- g. Explain why the death of a bird '*will increase the chance of survival for germinating seeds*'. (2 marks)
- (Total: 25 marks)**

3. After grape harvesting, it is traditional of Maltese farmers to make home-made wine. After crushing the grapes, adding sucrose, yeast and yeast nutrient, grape juice is filtered and stored in glass demijohns.

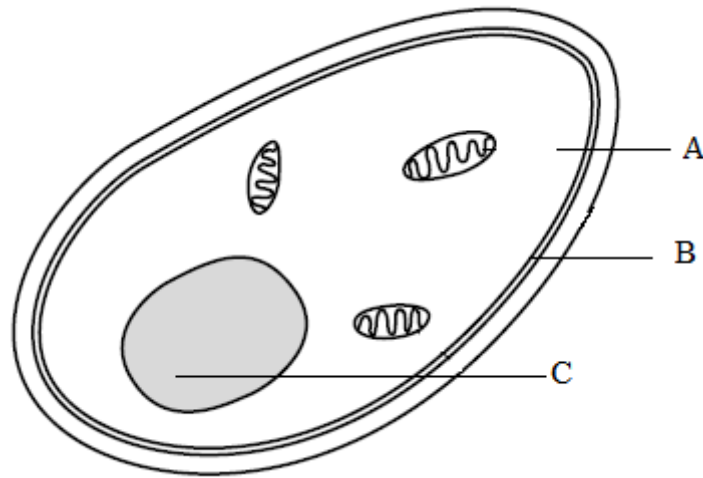


The table shows the first 20 days of the wine making process.

Time (days)	Concentration of sucrose/grams per dm ³	Concentration of alcohol in arbitrary units	Number of gas bubbles/ hour
2	325	0.0	100
4	225	0.0	50
6	150	1.0	30
14	100	2.0	10
20	60	4.0	5

- Name the chemical process by which alcohol is being produced. (1 mark)
- Name the gas produced in the glass demijohn. (1 mark)
- On the graph paper provided (use the 2mm grid scale), draw a line graph, to show the relationship between concentration of sucrose with time. Present the concentration of sucrose on the y-axis and time on the x-axis. (6 marks)
- State the concentration of sucrose on day 10. (2 marks)
- Describe the relationship between the concentration of alcohol and the number of gas bubbles in the demijohn. (2 marks)
- When the concentration of alcohol reached 15%, no more gas bubbles are produced. Explain why the alcohol content cannot increase further. (2 marks)

g. A diagram of a yeast cell is shown below.



- i. Name and state ONE function of each of the parts labelled A, B and C. (3, 3 marks)
 - ii. Name the kingdom to which yeast belongs. (1 mark)
 - iii. List TWO structural differences between yeast and plant cells. (4 marks)
- (Total: 25 marks)**

4. As the tiger occupies the upper trophic level in a food web, it is considered to be a top consumer. Top consumers are typically carnivores and are predators.

- a. Define the terms:
 - i) consumer; (2 marks)
 - ii) carnivore; (2 marks)
 - iii) predator. (2 marks)

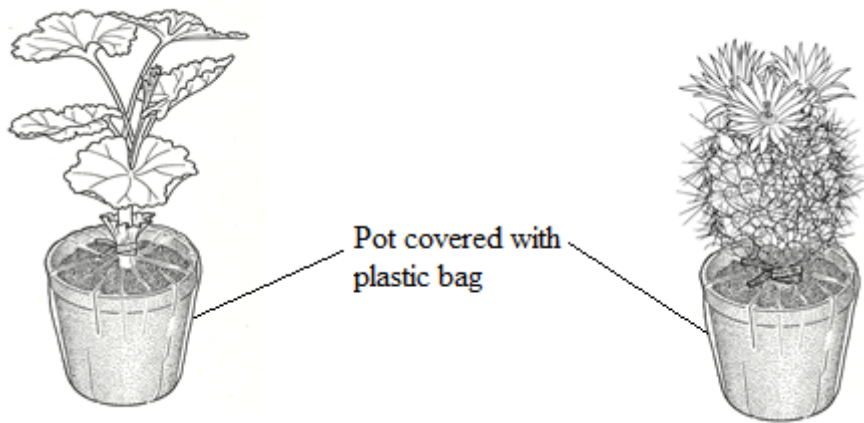
- b. Write a description of each of the below steps of nutrition and indicate where each step occurs in the body.
 - i) ingestion;
 - ii) digestion;
 - iii) absorption;
 - iv) assimilation;
 - v) egestion. (3, 4, 3, 3, 3 marks)

- c. Explain the following observation:
 - i) the tiger has prominent long and pointed canine teeth; (1 mark)
 - ii) the muscles attached to the jaw of the tiger allow it to have a strong bite but muscles responsible for chewing are weak. (2 marks)

(Total: 25 marks)

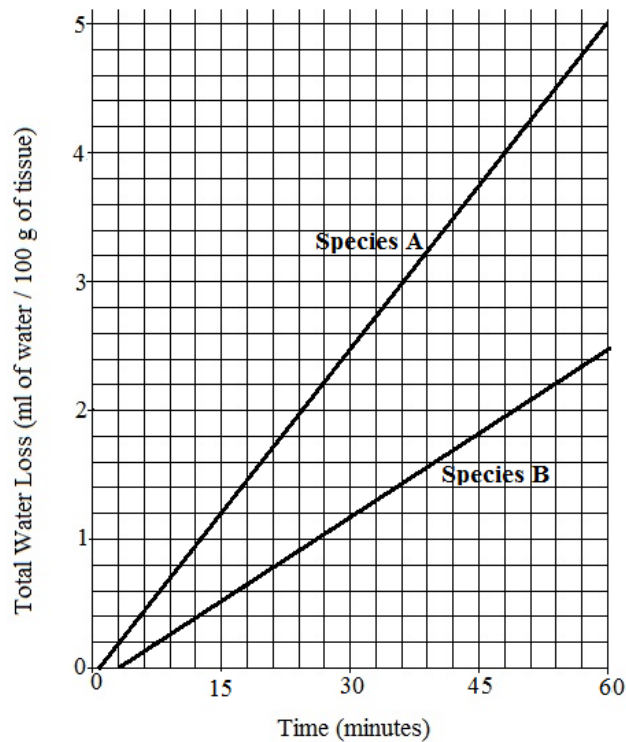
5. The small hive beetle *Aethina tumida* is an indigenous insect of the sun-Saharan desert. It has lately been observed in Southern Italy and is attacking the local honey bee hives. The small hive beetle is described as a pest, a parasite and a scavenger.
- Explain the term *scavenger*. (2 marks)
 - List the phylum of the beetle and give ONE characteristic feature of this phylum. (2, 2 marks)
 - Both the honey bee and the small hive beetle exhibit complete metamorphosis. Draw a diagram showing each stage of complete metamorphosis of an insect. Describe EACH stage. (6 marks)
 - The beetle harms the hive by burrowing through the hive comb. It leaves faeces that contain the yeast *Kodamaea ohmeri* which ferments the honey. On infestation the honey bees leave the hive and colony.
 - Honey is made from the nectar gathered by the bees from flowers. State the position of nectaries in the flower. (1 mark)
 - List the genus name of the yeast. (1 mark)
 - Insect-pollinated flowers have different features to ensure attraction and pollination by bees. Give ONE feature of an insect pollinated flower. (2 marks)
 - Another parasite on honey bees is the tracheal mite. The mite, an arachnid, lives in the trachea of the honey bee. The young mites pierce the host's trachea and feed on the bee's body fluids.
 - Give ONE difference between an insect and an arachnid. (2 marks)
 - Explain the role of the tracheal system in insects. (2 marks)
 - Insects need to conserve the water in their body. List TWO features of an insect that reduces loss of water from the body. (2 marks)
 - The house dust mite is another arachnid that can develop allergies on humans. In some it can cause persistent, harsh coughing. Explain how coughing may harm the lungs. (3 marks)
- (Total: 25 marks)**
6. The mammalian kidney is a homeostatic organ.
- Define the term *homeostasis*. (2 marks)
 - Draw a well-labelled cross-section of the mammalian kidney. In your drawing include the position of a nephron. (5 marks)
 - The nephron performs the functions of ultrafiltration, selective reabsorption and regulation of water and salts.
 - Name TWO substances which are filtered through the glomerulus and ONE substance that remains in the capillaries. (2, 1 mark)
 - Describe TWO features of the first convoluted tubule that increase the efficiency of selective absorption. (4 marks)
 - Describe the path blood takes from the capillaries surrounding the nephron to the right atrium of the heart. (2 marks)
 - Vitamin D can be produced by the skin on exposure to sunlight. It is processed by the liver and activated in the kidneys.
 - Name ONE other source of Vitamin D. (1 mark)
 - State the importance of this vitamin in the human body. (2 marks)
 - Kidney failure can lead to high blood pressure that affects the health of blood vessels and the heart.
 - List THREE differences between an artery and a vein. (3 marks)
 - Name and explain ONE lifestyle that may lead to high blood pressure. (1, 2 marks)
- (Total: 25 marks)**

7. Students carried out experiments to investigate the loss in mass of two different plant species. They enclosed each pot in a plastic bag and measured the mass of each plant at regular intervals during one hour.



- a. Students assumed that the loss in mass is entirely the result of transpiration of water from the shoot. Name ONE other process in the plant that is likely to cause a loss in mass. (1 mark)
- b. Explain the importance of enclosing the plant pot in a plastic bag. (2 marks)
- c. Both plants were placed first in the sunlight and then in the shade. What difference in the transpiration rates could be observed? (2 marks)
- d. Apart from light intensity, name ONE other environmental factor that can affect the rate of transpiration. Sketch a graph to show the relationship between the environmental factor and the rate of transpiration. (4 marks)
- e. State ONE reason why transpiration is an important process in plants. (2 marks)

- f. Students plotted a graph to show the total water loss per 100g of tissue for both plant species in 1 hour. The graph is shown below.



- i. How many ml of water are lost by Species A in 15 minutes. (2 marks)
 - ii. Calculate the rate of transpiration for species B between 30 and 45 minutes. (2 marks)
 - iii. Name the plant species that is more likely to survive in dry conditions. Give ONE reason for your answer. (2 marks)
 - iv. Name TWO structural adaptations that plants living in dry conditions have to conserve water. Explain how **each** adaptation contributes to reduce water loss. (4 marks)
- g. The human skin reacts to overheating in different ways. State TWO mechanisms and explain how they contribute to keep the body temperature constant. (4 marks)
- (Total: 25 marks)**

Please turn the page.

- 8a. Describe the beneficial aspect of the following on soil:
- i) earthworms; (4 marks)
 - ii) humus. (3 marks)
- b. Give a biological explanation of the following:
In 1911, the Ladybird beetle was introduced in Malta to control the Cottony Cushion Scale insect which attacks citrus plants. (3 marks)
- c. Scientists have utilised bacteria to modify crops such as corn and potatoes to produce a pesticide protein in their cells. This is toxic to the insect pest but not toxic to humans.
- i) Define *recombinant DNA*. (2 marks)
 - ii) Explain the use of vectors in genetic engineering. (2 marks)
- d. Explain why the following statements are incorrect.
- i) Bacteria are non-cellular microbes with genetic material surrounded by a protein coat. (3 marks)
 - ii) Mosses are plants that produce seeds in cones. (4 marks)
 - iii) Birds and reptiles are ectothermic. (4 marks)
- (Total: 25 marks)**