Index No. _____ SEC04/1.13m

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2013 SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	I
DATE:	10th May 2013
TIME:	4:00 p.m. to 6:00 p.m.

ANSWER ALL QUESTIONS IN THIS PAPER IN THE SPACES PROVIDED.

1. a. Name the **exact** location of **each** of the following structures in the human body:

Structure	Exact location
Adipose tissue	
Adrenal glands	
Cerebellum	
Tricuspid valve	
Ureter	

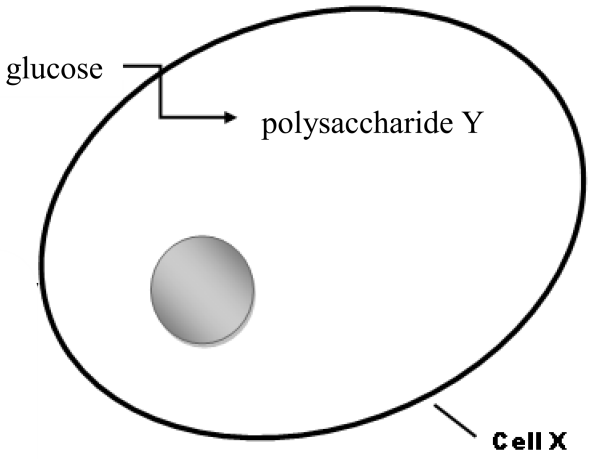
(1 mark each)

b. Name the exact location of **each** of the following structures in the flower:

Structure	Exact location
Nectary	
Pollen sacs	
Sepals	
Male nucleus	
Stigma	

(1 mark each)
(Total: 10 marks)

2. The diagram below shows a human cell, X. In this cell, absorbed glucose molecules are converted to polysaccharide Y in the presence of the hormone insulin.



a. i) Name polysaccharide Y.

_____

(1 mark)

ii) Name the 3 elements present in glucose.

_____

(1 mark)

b. i) Name the gland that produces the hormone insulin.

_____

(1 mark)

ii) Name **ONE** type of cell X, where glucose is converted to polysaccharide Y.

_____

(1 mark)

c. Insulin levels in a human are determined by monitoring the level of the hormone in blood. Explain why blood is used.

_____

_____

(2 marks)

d. When a human has not eaten for several hours, the hormone glucagon is produced.

i) Describe the stimulus that initiates the secretion of glucagon.

_____

_____

(2 marks)

ii) State why it is important to keep a constant level of glucose in blood.

(1 mark)

(Total: 9 marks)

3. The Greater Weever (Maltese name: Is-Sawt il-Kbir), *Trachinus draco* is a species of fish displayed in one of the tanks at the Malta National Aquarium.

This fish normally lives at the bottom of the Mediterranean Sea. The first dorsal fin, located on the back of the fish, and the operculum have venom glands (poison glands) which when pressed secrete a toxin.

a. Name the genus of the Greater Weever.

(1 mark)

b. The venom glands found on the dorsal fin and operculum have a defence function against attack from predators. What is the advantage of placing these glands on the:
i) dorsal fin:

(2 marks)

ii) operculum.

(1 mark)

c. The Greater Weever is a silvery beige fish with brown spots on its back. Sometimes it burrows in sand. Explain how the fish skin colour enables it to survive in the bottom of the Mediterranean Sea.

(1 mark)

d. At times this fish species is attacked by water lice. The water louse enters the fish through the gills and moves to the mouth where it first feeds on the tongue of the fish and then feeds on any food ingested by the fish. The fish is harmed while the water louse benefits from this association. Name the association between the water louse and the fish.

(1 mark)

e. At the Malta National Aquarium, students are given the opportunity to observe several aquatic species such as crabs, starfish and sea urchins present in the touch pools.

i) Crabs are Arthropods. Name the class to which crabs belong.

(1 mark)

ii) The following table lists three species of crabs displayed in one of the touch pools.

Common name	Scientific name
Spider crab	*Maja squinado*
Warty crab	*Eriphia verrucosa*
Marbled rock crab	*Pachygraspus marmoratus*

Explain why these crabs are not closely related.

(1 mark)
(**Total: 8 marks**)

4. A biology student investigated the action of lipase, by setting up three testubes A, B and C. Each contained an equal volume of full-fat milk and an indicator. The indicator is pink in the presence of fat but turns colourless on the breakdown of fat molecules.

The table below shows the contents added to each test-tube and the time taken for the reaction to occur.

TESTUBE	CONTENTS	TIME FOR INDICATOR TO TURN COLOURLESS / s
A	Full fat milk + indicator + **Lipase**	16
B	Full fat milk + indicator + **Boiled lipase**	Remains pink
C	Full fat milk + indicator + **Lipase and bile**	9

a. i) Name the products formed when fat is broken down by the action of lipase.

(2 marks)

ii) Explain why the same volume of milk was placed in each test-tube.

(2 marks)

b. i) What happens to lipase when it is boiled?

(1 mark)

ii) Explain why the boiled enzyme in tube B failed to breakdown the fat.

(2 marks)

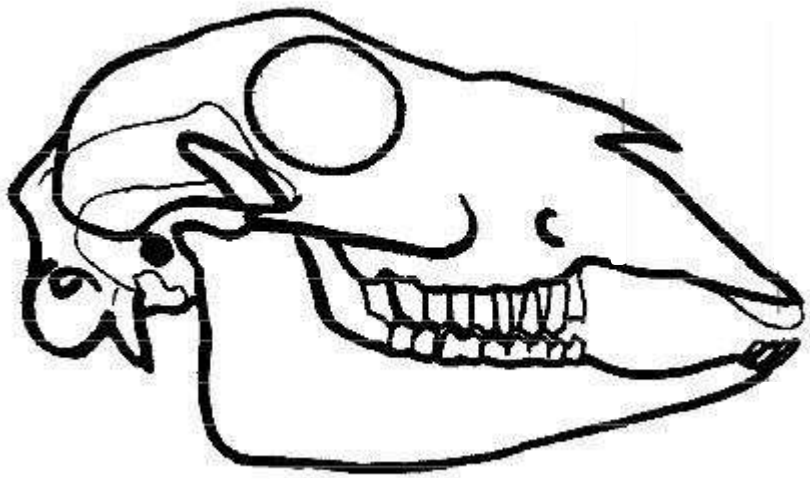
c. i) Describe the function of bile in test-tube C.

(2 marks)

ii) Explain why the breakdown of fats in test-tube C took the shortest time.

(2 marks)
(**Total: 11 marks**)

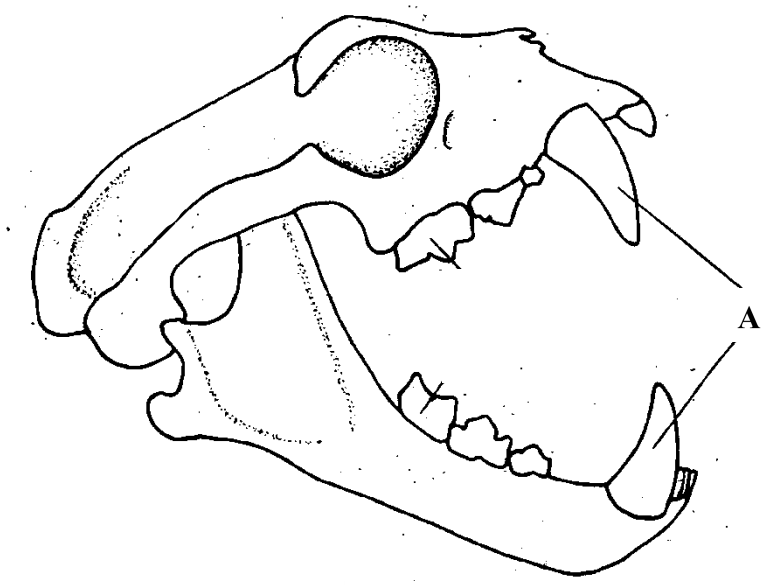
5. The following diagram shows the skull of a typical herbivore.



a. On the diagram label
   i) the incisors
   ii) the diastema
   iii) the horny pad.

(3 marks)

b. The following diagram shows the skull of a lion.



List **TWO** visible differences in the dentition of the typical herbivore and the dentition of the lion.

(2 marks)

c. Explain why the teeth labelled A are large and pointed.

(1 mark)

d. Name the organ in the lion where excess amino acids are deaminated.

(1 mark)

e. Explain why the duodenum, the ileum and the colon in a lion are not greatly elongated.

(1 mark)

f. Lions hunt and kill efficiently. Describe **ONE** strategy that allows lions to be successful predators.

_____

_____

(1 mark)

g. Lions have been known to breed with tigers to create hybrids called tigons. The tigon is a cross-breed between a male tiger and a female lion. The chromosome number in both tigers and lions is 38. Write the chromosome number in the:

i) bone cells of the tigon; _____

ii) gametes of lions. _____

(2 marks)

h. Explain why human body cells have 46 chromosomes, but fully specialised red blood cells lack chromosomes.

_____

_____

(1 mark)

(Total 12 marks)

6. Researchers at the University of Cincinnati discovered a new genetic mutation responsible for deafness and hearing loss associated with Usher Syndrome Type I. Usher syndrome is a rare genetic disorder that causes deafness, decreased night vision and a loss of peripheral (side) vision. In this study the researchers were able to pinpoint the gene that causes deafness in the Usher Syndrome Type I. Usher syndrome is inherited as an autosomal recessive trait.

(source: *www.sciencedaily.com/releases/2012/09*)

a. From the passage above, write the term that best describes:

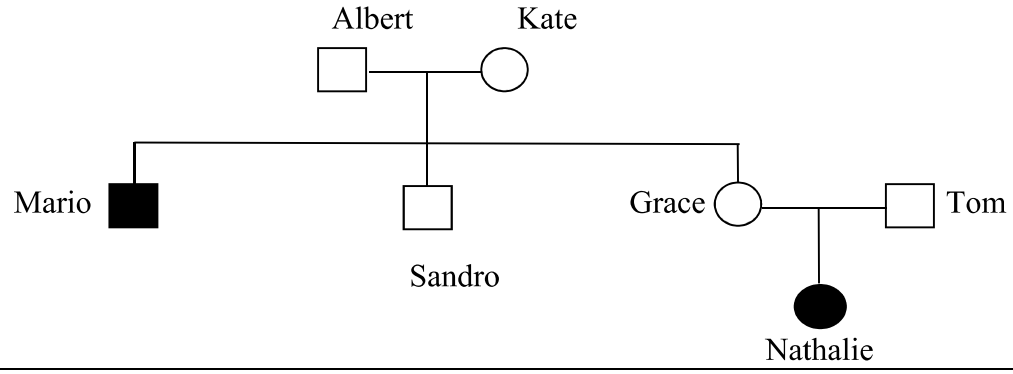
i) a molecular unit of heredity of a living organism; _____

ii) a change in the genetic code. _____

(2 marks)

Please turn the page.

b. The following diagram shows the inheritance of the syndrome in a family.



Key:	Normal female	Normal Male	
	Female suffering from Usher Syndrome type I	Male suffering from Usher Syndrome type I	

Using the letter **S** to represent normal (unaffected) and **s** to represent affected with Usher Syndrome Type I, write the genotypes of:

i) Albert; _____

ii) Nathalie. _____

(2 marks)

c. Grace and Tom had a second child, Matthew, who was not affected by Usher Syndrome. Complete the genetic diagram to show the two possible genotypes of Matthew.

Parents:	**Grace**		**Tom**	
Genotype of parents				
Gametes:				
F1 generation:				

The two possible genotypes of Matthew are: _____

_____

(4 marks)

d. Mario married Veronica who has no history of Usher Syndrome in her family. Complete the genetic diagram to show that Mario and Veronica cannot have children who suffer from this disease.

Parents:	**Mario**		**Veronica**	
Genotype of parents				
Gametes:				
F1 generation:				

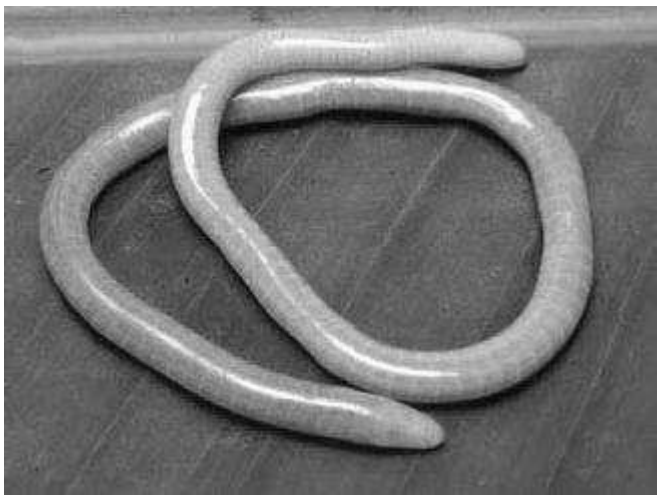
Explanation: _____

_____

(5 marks)

(**Total 13 marks**)

7. The photo below shows a **caecilian** (prononounced 'siss-ee-lee-an'). It is an amphibian which is often mistaken for an earthworm or a snake. Caecilians feed mostly on invertebrates such as worms or termites. Many species burrow in soil or hide under leaf litter, often coming out only at night. Other species live in fully or semi-aquatic habitats. Most caecilians are found in moist tropical regions.



a. Name the phylum to which amphibians belong.

_____

(1 mark)

b. i) List **ONE** internal structural characteristic present in a caecilian but absent in an earthworm.

_____

(1 mark)

ii) List **ONE** difference between the skin surface of the caecilian and the skin surface of a snake.

(2 marks)

c. Explain why most caecilians are found in 'moist' habitats.

(2 marks)

d. Some caecilian species give birth to live young. The fertilized eggs are kept inside the mother's body before hatching. This increases the chances of survival of the young caecilians.

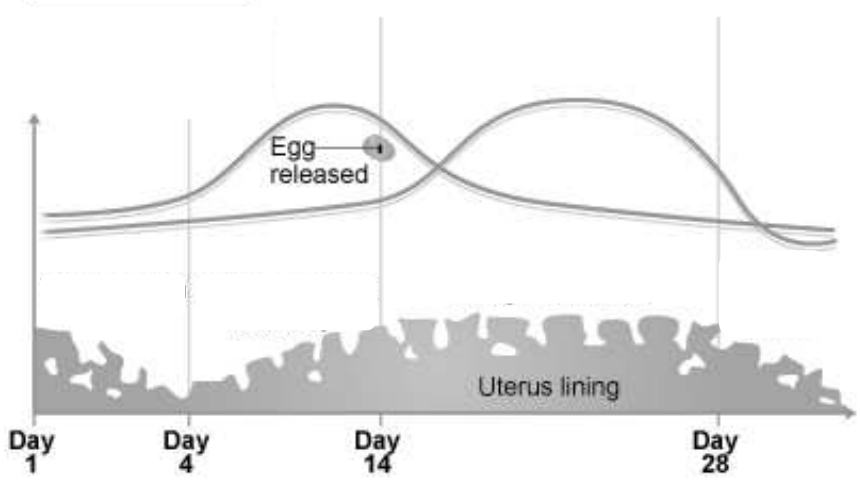
i) Name another group of animals that characteristically give birth to live young.

(1 mark)

ii) Give **ONE** reason why keeping fertilized eggs inside the mother's body increases the chances of survival of young caecilians.

(2 marks)
(**Total 9 marks**)

8. The following graph shows the changes in the uterine lining and in the level of the two hormones progesterone and oestrogen during the menstrual cycle.



a. Name the gland that secretes the hormones oestrogen and progesterone.

(1 mark)

b. On the graph above, label clearly the line representing progesterone with a **P** and the one representing oestrogen with an **O**. (2 marks)

c. Describe what happens to the level of progesterone once a woman becomes pregnant.

(1 mark)

d. Oestrogen stimulates the release of Luteinising Hormone (LH). Name the gland that secretes LH.

(1 mark)

e. i) Define the term *zygote*.

(1 mark)

ii) Name the organ that develops to provide the foetus with its requirements in a pregnant female, once implantation is complete.

(1 mark)

f. Name the type of birth control method used by females that prevents sperms from entering the uterus.

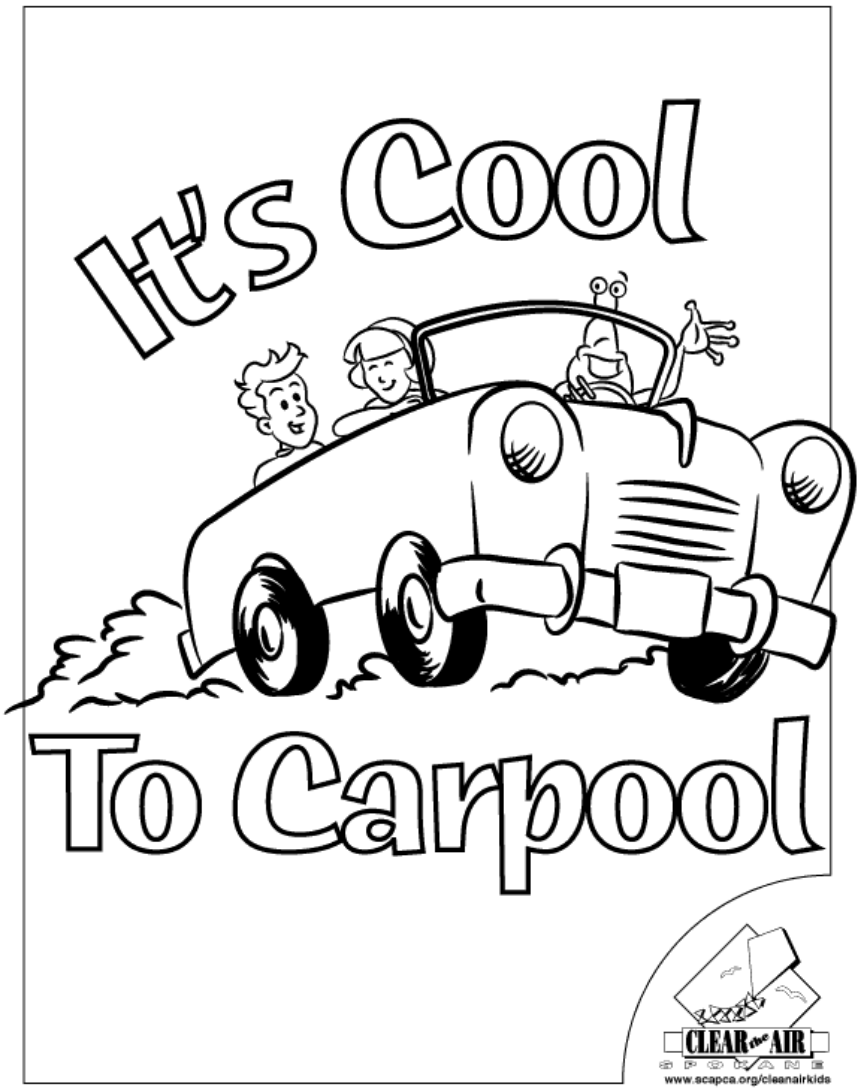
(1 mark)

g. A number of females prefer natural birth-control methods such as the Temperature method and the Mucus (Billing's) method. Distinguish between the Temperature method and the Mucus method.

(2 marks)
(**Total 10 marks**)

9. a. Give a biological explanation for **each** of the following posters.

i)



(3 marks)

ii)

(2 marks)

iii)

(2 marks)

Please turn the page.

b. List **TWO** possible ways to prevent the situation in the following poster.

(2 marks)
(Total: 9 marks)

10. a. Distinguish between
i) *diffusion* and *active transport*;

(2 marks)

ii) *transpiration* and *translocation*;

(2 marks)

iii) *interspecific* and *intraspecific* competition.

(2 marks)

b. Mitosis and meiosis are two important processes occurring in the body.

i) List **ONE** similarity observed in both processes.

(1 mark)

ii) List **TWO** differences observed in the two processes.

(2 marks)

(Total: 9 marks)

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2013 SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IIA
DATE:	11th May 2013
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.

Sloths are tree-dwelling mammals that spend most of their life hanging upside down – they usually eat, sleep and even give birth in this position. They move very little … and very slowly. They have short, flat heads with big eyes, a short snout and tiny ears. Sloths are related to anteaters and armadillos. There are two different families of sloth – two fingered and three fingered. These two families found today are only distant relatives and began to evolve independently of each other 65 million years ago, while adopting remarkably similar lifestyles in the tree canopies of South and Central America. Currently there are just six species of sloth – all of which are found in regions where the tropical climate maintains relatively warm temperatures all year around.

The two fingered sloths have mostly blonde or light brown hair and are nocturnal (active during the night). In contrast, three fingered sloths are active in the day, and have mostly grey hair with a characteristic racoon-like mask around the eyes and a short tail.

Sloths live on an unusual diet. They eat the leaves in the tree canopy – but this is an extremely low-energy diet that is both difficult to digest and is rich in poisons. Few other mammals could survive on such food. Both families of sloths have evolved large, slow-acting four-chambered stomachs that contain bacteria. These bacteria produce enzymes that help to break down the tough leaves.

The key to the sloth's slow pace is their low-energy diet. The diet supplies little energy because it is hard to digest and so low in calories. To survive on their low-calorie diet, sloths have evolved a low metabolic rate and have approximately 20% less muscle mass than other mammals – so fast movement is virtually impossible for them. Therefore to avoid predation and conserve energy, they have adopted a 'slow and careful' strategy. They also conserve energy by reducing their ability to thermoregulate and can withstand unusually low and variable body temperatures. Most mammals maintain a relatively stable body temperature of approximately 36^{o}C. The body temperature of a sloth, however, regularly fluctuates by over 4^{o}C throughout the course of a single day. Sloths are unable to sweat, pant or shiver. They rely on behavioural methods in order to keep warm or cool.

(Adapted from Cliffe R., *Sloths: life in the slow lane;*
Biological Sciences Review Vol 25, No 2. Nov. 2012)

a. Sloths are classified as mammals. Give **TWO** distinctive features expected to be observed in sloths to support this classification. (2 marks)

b. i) Define the term *species*. (2 marks)

ii) Give **TWO** distinguishing features that allowed scientists to classify different species of sloths in the two different families. (2 marks)

c. i) Suggest why sloths have a slow acting stomach. (1 mark)
ii) What is the role of bacteria in the stomach of sloths? (2 marks)

d. Explain how a low calorie diet results in:
i) a low metabolic rate; (2 marks)
ii) very slow movement. (1 mark)

e. Describe a behavioural method that helps sloths to prevent an increase in their body temperature. (1 mark)

(**Total 13 marks**)

2. The following table lists the number of threatened species of vertebrates in 2007 and 2011.

Vertebrates	**Threatened species in 2007**	**Threatened species in 2011**
Mammals	1094	1138
Birds	1217	1253
Reptiles	422	772
Amphibians	1808	1917
Fish	1201	2028

(Source: The IUCN Red list of Threatened species)

a. On the graph paper provided draw **TWO** bar charts on the same axes to show the number of threatened species for each vertebrate group in 2007 and 2011. For each vertebrate group draw the bars next to each other. (6 marks)

b. Calculate the percentage increase in the number of threatened fish species. (2 marks)

c. The increasing demand for fish resulted in widespread overfishing. Fish farms are raising fish commercially in tanks, usually for food. Pesticides are regularly added to water in fish farms. State **ONE** advantage and **ONE** disadvantage of the use of pesticides in fish farms. (2 marks)

d. Recent studies suggest that overfishing of large shark species had a ripple effect on the shark's food chain, increasing the number of species of manta-rays that are usual prey for large sharks.

i) Name the **type** of organism at the start of all food chains. (1 mark)
ii) Suggest what might be the effect of the increase in the number of species of manta rays on the number of smaller fish and shellfish that are the typical food of manta rays. (1 mark)

(**Total 12 marks**)

Section B: Answer any THREE questions from this section.

3. Water is the main constituent of fluids in organisms from cytoplasm in cells to blood plasma in animals.

a. State **ONE** role of water in the:
   i) cytoplasm;
   ii) permanent plant cell vacuole;
   iii) blood plasma. (3 marks)

b. A potometer measures the rate of water uptake in a shoot.
   i) Describe **TWO** precautions a student should take when setting up a potometer to ensure that the apparatus works correctly. (4 marks)
   ii) A student used a potometer to compare the rate of water uptake of two shoots in still air and in very humid conditions. Describe the method used by the student. (5 marks)

c. Mineral ions are absorbed by the roots from the surrounding soil.
   i) Explain how mineral ions are absorbed by roots. (3 marks)
   ii) What will happen to a plant growing in soil which lacks magnesium? (2 marks)

d. List **TWO** features of plants adapted for living in dry habitats. (2 marks)

e. Capillaries play an important role in the exchange of substances between blood and tissues in the body.
   i) Describe **TWO** structural features that make capillaries well adapted to allow the efficient exchange of substances between blood and tissues. (2 marks)
   ii) What is the role of tissue fluid in capillary exchange? (1 mark)
   iii) Explain why oxygen moves from capillaries to muscle tissue while carbon dioxide moves from the tissue into blood. (3 marks)

(**Total: 25 marks**)

4. a. Give a biological explanation for **each** of the following statements.

   i) Carbohydrate digestion and protein digestion take place in different parts of the alimentary canal. (4 marks)
   ii) The blood supply to the liver is different from that of other organs. (3 marks)
   iii) Blood has an important protective function. (3 marks)
   iv) A 12-year old boy usually has no facial hair, however a 15-year old boy starts growing facial hair. (3 marks)

b. Explain why **each** of the following statements is **incorrect**.

   i) The nature of the messages and the speed of action in the nervous and endocrine systems is the same. (4 marks)
   ii) Both sandy soil and clay soil are difficult to dig. (4 marks)
   iii) When two ova are released from the ovaries of a female at the same time, identical twins result, following fertilisation. (4 marks)

(**Total: 25 marks**)

5. *Ecological footprint analysis* measures environmental sustainability; that is, it measures demands humans make on the ecosystems of the Earth. Two of the factors studied in ecological footprint analysis are the consumption of water and carbon dioxide emissions in air.

a. Define the term *ecosystem*. (2 marks)

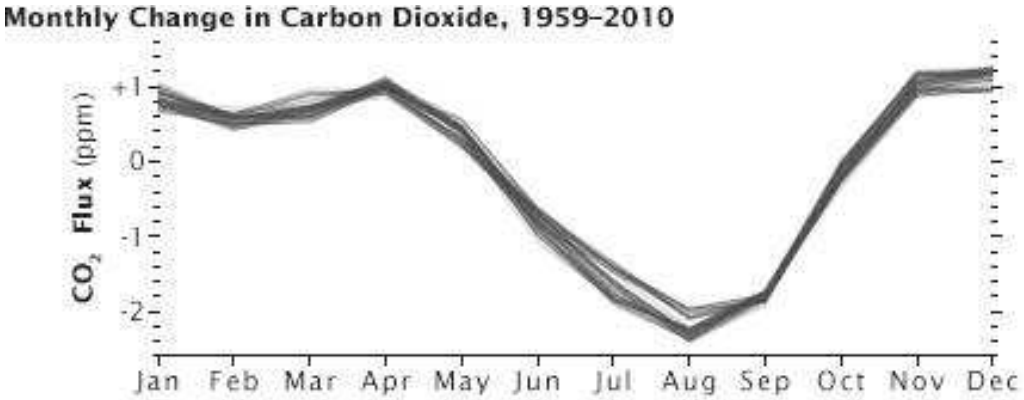
b. The Water Catchment Management plan for the Maltese Islands (March 2011) lists the island's surrounding coastal waters, ground water (from water seeping through rock) and inland waters as part of its management strategy.

i) The report states that the extraction of ground water for human consumption from certain areas has been discontinued as the ground water had high nitrate content. List **ONE** way how the action of humans has increased the level of nitrates in ground water. (2 marks)

ii) The report also states that the coastal region of *Il-Port il-Kbir* (Grand Harbour) has a low diversity in marine flora and fauna. Give **TWO** reasons why this area has a low diversity of organisms. (4 marks)

iii) Inland waters such as *is-Simar* fluctuate in water volume and salinity throughout the year. In winter inland water increases and salinity decreases while in summer the marshland decreases and salinity increases. Use the water cycle to explain the changes in water volume and salinity. (4 marks)

c. The graph below shows the fluctuation of carbon dioxide in air between January and December in several years. Readings were taken between the years 1959 and 2010 in the Northern hemisphere (contains most of Earth's land).



(Source: earthobservatory.nasa.gov/Features/Carboncycle/page3.php)

i) Carbon dioxide decreases in air in spring and in summer. During this time frame there is an increase in plant growth. Explain the link between the decrease in CO_2 levels, photosynthesis and the increase in plant growth. (4 marks)

ii) Decomposition and respiration are two processes that release CO_2 in the air. These contribute to the release of CO_2 in the atmosphere during the autumn and winter months. What is decomposition? Name a group of organisms responsible of decomposition. (3 marks)

iii) Describe **ONE** human activity that increases carbon dioxide levels in the atmosphere. (2 marks)

d. Emissions of CFC (chlorofluorocarbons) are a major cause of the depletion of the ozone layer. Explain **TWO** environmental effects of the thinning out of the ozone layer. (4 marks)

(Total 25 marks)

6. Growth responses in plants are slower than in animals.

a. A student holds a ruler vertically against another student's hand. When the first student releases the ruler, the second student tries to grip the ruler to stop its fall. This response is a reflex response.

i) Describe the pathway involved in producing a reflex action. (4 marks)

ii) Explain why the time lapse between the stimulus and the response is very short. (2 marks)

iii) State the role of endocrine glands in response to a stimulus. (2 marks)

b. The skin dermis contains several sense receptors some of which sense the external surrounding temperature. A student was in a warm room. After half an hour, the student started to sweat.

i) Describe how sweat cools the body. (2 marks)

ii) The student then had an ice lolly. Explain the change observed in the sweating rate. (2 marks)

iii) Thermoregulation keeps the body temperature within a narrow range. List **ONE** danger to the human if the body is unable to thermoregulate. (2 marks)

c. In an investigation on tropisms, a pot of seedlings was put in a box and exposed to light from one direction. Photographs taken every 15 minutes for 5 days show the shoots growing towards the light source.

On the sixth day, the seedlings were exposed to light from all directions.

i) Describe the changes occurring inside the shoots that cause them to grow towards light. (3 marks)

ii) Describe the growth of the shoot when exposed to light from all directions. Give **ONE** reason for your answer. (3 marks)

iii) When the seedlings were put near a light source, they turned green as they produced chlorophyll. Explain the importance of this observation. (2 marks)

iv) Hydrotropism is a growth response to water. Suggest if roots are expected to exhibit a positive (grow towards water) or negative (move away from water) hydrotropism. Give **ONE** reason for your answer. (3 marks)

(Total: 25 marks)

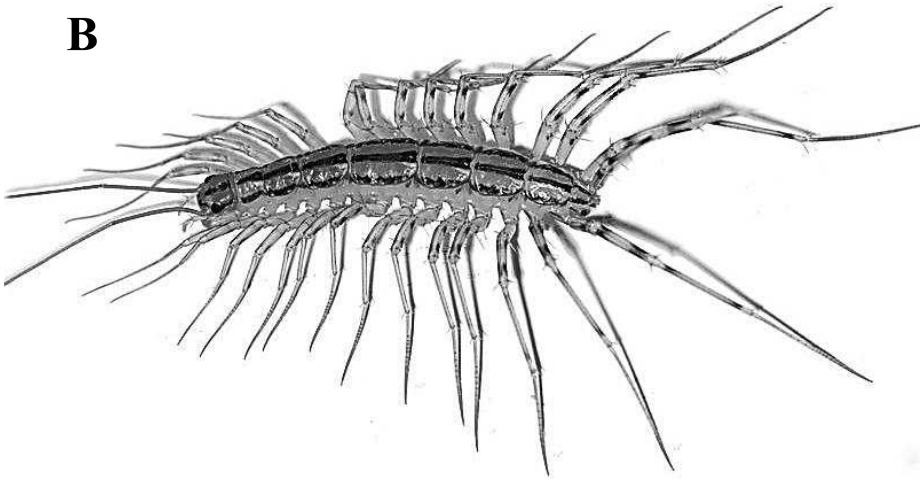
Please turn the page.

7. a. Photographs **A** to **D** show a selection of arthropods found in the Maltese Islands. For **each** arthropod the following names are given: the scientific name, the common English name and the common Maltese name.

A

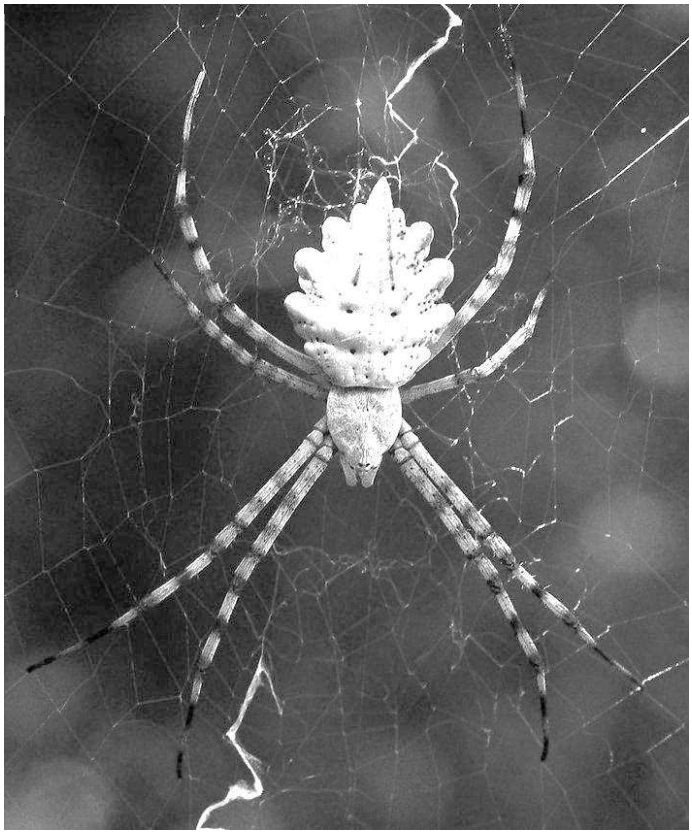
Scientific name: *Creophilus maxillosus*
Common English name: Rove beetle
Common Maltese name: Kappillan
(Source: http://www.biolib.cz/IMG/GAL/BIG/149466.jpg)

B



Scientific name: *Scutigera coleoptrata*
Common English name: House centipede
Common Maltese name: Xini tal-Indewwa)
(Source: http://upload.wikimedia.org/wikipedia/commons/1/14/Scutigera_coleoptrata.JPG)

C



Scientific name: *Argiope lobata*
Common English name: Lobed Argiope
Common Maltese name: Brimba Kbira tal-Widien
(Source: http://0.static.wix.com/media/471c81_7f362913d52e63f2e582f63c0bf77ae4.jpg_1024)

D

Scientific name: *Armadillidium vulgare*
Common English name: Common Woodlouse
Common Maltese name: Ħanżir l-art komuni
(Source: http://upload.wikimedia.org/wikipedia/commons/c/c6/Armadillidium_vulgare_DSC_9278.lr3.jpg)

Please turn the page.

i) List **TWO** advantages of using the binomial system to name and classify each organism. (4 marks)

ii) Give **TWO** visible features in the photos that confirm that all four organisms (A to D) shown are all arthropods. (2 marks)

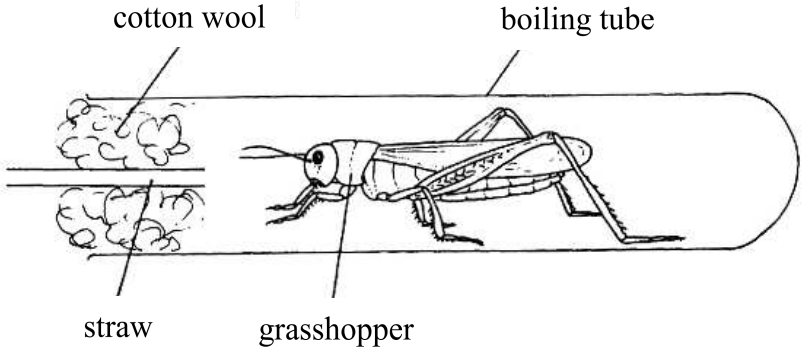
iii) Name the arthropod class of **each** organism shown in photographs A to D. In **each** case give **ONE** reason for your choice. (8 marks)

b. A student was asked to investigate the effect of the level of oxygen and carbon dioxide on the rate of gas exchange in a grasshopper. Although planning of investigation started early in January, grasshoppers were only found in March.

i) Explain why the student did not find any grasshoppers before March. (2 marks)

ii) Describe how the student caught the grasshoppers. (1 mark)

c. In the investigation the student set up the apparatus below. After allowing the grasshopper to stay in the boiling tube for five minutes, he counted the number of times the spiracles opened and closed in one minute. Then the student breathed twice through the straw into the boiling tube and again counted the number of times the spiracles opened and closed in one minute.



The student observed that the activity of the spiracles increased significantly when he breathed into the boiling tube.

i) What is the role of the spiracles in the grasshopper? (2 marks)

ii) State exactly where the spiracles may be observed on the grasshopper body surface. (2 marks)

iii) How do the oxygen and carbon dioxide content in the boiling tube vary after the student breathes into the tube? (2 marks)

iv) Explain why the activity of the spiracles of the grasshopper increased significantly after the student breathed into the boiling tube. (2 marks)

(**Total: 25 marks**)

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2013 SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IIB
DATE:	11th May 2013
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 1 of this paper you need the graph paper in the booklet.

Answer ANY FOUR (4) questions. Each question carries 25 marks.

1. The following table lists the number of threatened species of vertebrates in 2011.

Vertebrates	Threatened species in 2011
Mammals	1138
Birds	1253
Reptiles	772
Amphibians	1917
Fish	2028

(Source: The IUCN Red list of Threatened species)

a. On the graph paper provided draw a bar chart to show the number of threatened species for each vertebrate group in 2011. Label the bars clearly. (6 marks)

b. Use the table to calculate the total number of threatened species that are endotherms. (2 marks)

c. The increasing demand for fish resulted in widespread overfishing. Fish farms are raising fish commercially in tanks, usually for food.
   i) Explain why pesticides are regularly added to water in fish farms. (2 marks)
   ii) Excess food and fish faeces create a nutrient-rich environment below the netted area in fish farms. Explain how this affects the amount of oxygen in the water. (2 marks)

d. Recent studies suggest that over fishing of large sharks species had a ripple effect on the shark's food chain increasing the number of species of manta-rays that are the usual prey for large sharks. In turn this affects the number of smaller fish and shell fish that manta rays feed on.
   i) Plants or algae are found at the start of all food chains. Write the term describing the organism found in the first trophic level and explain why they occupy the first trophic level in the food chain. (3 marks)
   ii) Sharks are carnivorous. What does this mean? (2 marks)
   iii) Describe the effect of an increase in the number of manta rays on the populations of smaller fish and shellfish. (2 marks)

e. What trophic levels in a food chain are occupied by primary and secondary consumers. (2 marks)

f. List **TWO** ways how the amount of energy along a food chain is reduced. (4 marks)

(Total 25 marks)

2. Sloths are mammals that live in trees. They spend most of their life hanging upside down – they usually eat, sleep and even give birth in this position. They move very little … and very slowly. They have short, flat heads with big eyes, a short snout and tiny ears. Sloths are related to two other mammals: the anteaters and the armadillos.

a. i) Name the kingdom and phylum to which sloths, anteaters and armadillos belong. (2 marks)

ii) Sloths are classified as mammals. Describe **ONE** distinctive feature expected to be observed in sloths to support this classification. (2 marks)

b. There are two different families of sloth – two fingered and three fingered. They have similar lifestyles, living in the upper parts of trees in forests within South and Central America. There are now just six species of sloth alive today – all of them are found in regions where the tropical climate maintains relatively warm temperatures all around.

The two fingered sloths have mostly blonde or light brown hair and are active during the night. On the other hand, three fingered sloths are active in the day, and have mostly grey hair with a characteristic racoon-like mask around the eyes and a short tail.

i) What is a *species*? (2 marks)

ii) Give **TWO** distinguishing features that allowed scientists to classify different species of sloths in two different families. (4 marks)

c. i) Define the term *habitat*. (2 marks)

ii) Describe, as precisely as possible, the habitat of sloths. (2 marks)

d. Sloths live on an unusual diet. They only eat leaves – but this is an extremely low-energy diet and is difficult to digest. Few other mammals could survive on such food. Both families of sloths have large, slow-acting four-chambered stomachs that contain bacteria. These bacteria produce enzymes that help to break down the tough cell walls of the cells in the leaves.

i) Describe the role of these bacteria in the stomach of sloths. (2 marks)

ii) Sloths also regurgitate and chew their food. Describe the advantage of this behaviour. (2 marks)

e. Sloths are very slow as their diet contains a very low amount of energy. The diet supplies little energy because it is so low in calories and hard to digest. To survive on their low-calorie diet, sloths have evolved a low metabolic rate.
Explain how a low amount of energy in the diet results in a low metabolic rate. (3 marks)

f. Sloths also conserve energy by reducing their ability to control their body temperature. They can withstand unusually low and variable body temperatures. Sloths cannot pant. They only use behavioural methods to keep warm or cool down.

i) What is the role of panting in controlling body temperature? (2 marks)

ii) Suggest **ONE** behavioural way how sloths can lower down their temperature. (2 marks)

(Adapted from Cliffe R., *Sloths: life in the slow lane;*
Biological Sciences Review Vol 25, No 2. Nov. 2012)

(Total 25 marks)

3. Water is the main constituent of fluids in organisms from cytoplasm in cells to blood plasma in animals.

a. Describe **ONE** role of water in the:
   i) cytoplasm;
   ii) blood plasma. (4 marks)

b. A potometer measures the rate of water uptake in a shoot.
   i) Outline how a student can set up a potometer to measure the rate of water uptake of a shoot. (5 marks)
   ii) How does wind affect the rate of transpiration? Give a reason for your answer. (3 marks)

c. Mineral ions are absorbed by the roots from the surrounding soil.
   i) Name and describe the process by which mineral salts are taken up from the soil solution. (3 marks)
   ii) Describe what happens to a plant growing in soil which lacks magnesium? (2 marks)

d. List **TWO** features of plants adapted to live in dry habitats. (4 marks)

e. Capillaries play an important role in the exchange of substances between blood and tissues in the body.
   i) List **ONE** feature that makes capillaries adapted to allow the efficient exchange of substances between blood and tissues. (2 marks)
   ii) Describe the role of tissue fluid in exchanging excretory compounds from cells to blood. (2 marks)

(**Total: 25 marks**)

4. a. Give a biological explanation for **each** of the following statements.
   i) A 12-year old boy usually has no facial hair, however facial hair starts to grow in a 15-year old. (5 marks)
   ii) Both the endocrine and nervous systems send messages around the body. However the type of messages and the speed at which they are delivered vary. (4 marks)
   iii) Identical twins have copies of the same set of genes. (5 marks)

b. Explain why **each** of the following statements is **incorrect**.
   i) Digestion of carbohydrates occurs in the stomach. (3 marks)
   ii) All glands are ductless glands. (3 marks)
   iii) The rate of photosynthesis is only affected by the intensity of light. (5 marks)

(**Total: 25 marks**)

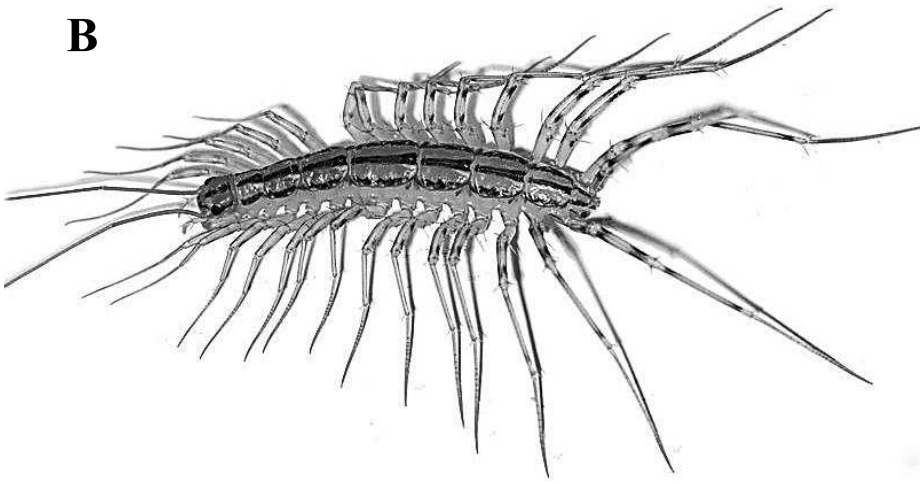
Please turn the page.

5. a. Photographs **A** to **D** show a selection of arthropods found in the Maltese Islands. For **each** arthropod the following names are provided: the scientific name, the common English name and the common Maltese name.

A

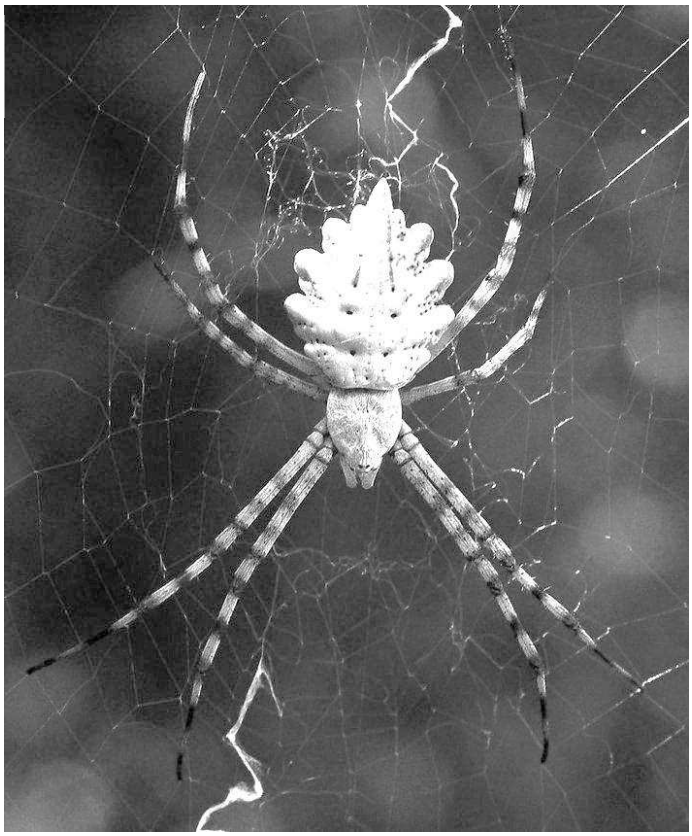
Scientific name: *Creophilus maxillosus*
Common English name: Rove beetle
Common Maltese name: Kappillan
(Source: http://www.biolib.cz/IMG/GAL/BIG/149466.jpg)

B



Scientific name: *Scutigera coleoptrata*
Common English name: House centipede
Common Maltese name: Xini tal-Indewwa)
(Source: http://upload.wikimedia.org/wikipedia/commons/1/14/Scutigera_coleoptrata.JPG)

C



Scientific name: *Argiope lobata*
Common English name: Lobed Argiope
Common Maltese name: Brimba Kbira tal-Widien
(Source: http://0.static.wix.com/media/471c81_7f362913d52e63f2e582f63c0bf77ae4.jpg_1024)

D

Scientific name: *Armadillidium vulgare*
Common English name: Common Woodlouse
Common Maltese name: Ħanżir l-art komuni
(Source: http://upload.wikimedia.org/wikipedia/commons/c/c6/Armadillidium_vulgare_DSC_9278.lr3.jpg

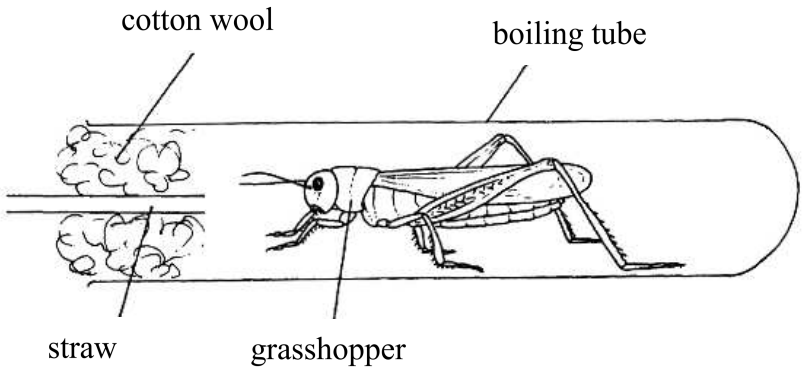
Please turn the page.

i) Describe **ONE** advantage of using the binomial system to name and classify each organism. (2 marks)

ii) List **ONE** visible feature in all the photos that confirms that all the organisms are arthropods. (2 marks)

iii) Name the arthropod class of **each** organism shown in photographs A to D. In **each** case give **ONE** reason for your choice. (12 marks)

b. A student investigated the effect of the levels of oxygen and carbon dioxide on the rate of gas exchange in a grasshopper.
In the investigation the student set up the apparatus shown below. After allowing the grasshopper to stay in the boiling tube for five minutes, the student counted the number of times the spiracles opened and closed in one minute. Then the student breathed twice through a straw into the boiling tube and again counted the number of times the spiracles opened and closed in one minute. The student observed that the activity of the spiracles increased significantly when he breathed into the boiling tube.



i) Describe the role of the spiracles in the grasshopper. (4 marks)

ii) Describe how the oxygen and carbon dioxide content in the boiling tube vary after the student breathes into the tube. (2 marks)

iii) Explain why the activity of spiracles of the grasshopper increased significantly after the student breathed into the boiling tube. (3 marks)

(**Total: 25 marks**)

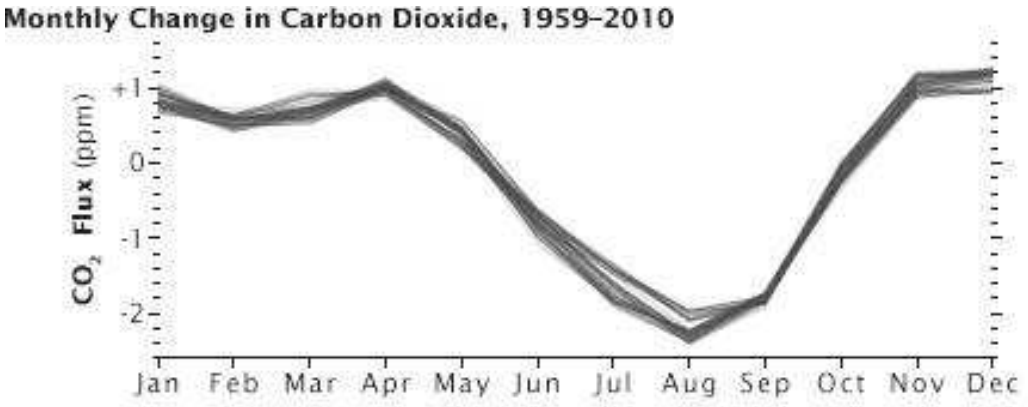
6. a. The Water Catchment Management plan for the Maltese Islands (March 2011) lists the islands' surrounding coastal waters, ground water (from water seeping through rock) and inland waters (such as *is-Simar*) as part of its management strategy. Inland water is a habitat where fresh water mixes with sea water.

i) Extraction of groundwater for human consumption from certain areas has been discontinued as the groundwater had a high nitrate content. List **ONE** human activity which leads to an increase in nitrate levels in ground water. (2 marks)

ii) The water volume and salinity of inland waters fluctuates throughout the year. In winter the volume of inland water increases and salinity decreases while in summer the volume of inland water decreases and salinity increases. Use the water cycle to explain the changes in water volume and salinity. (4 marks)

b. *Is-Simar* is also a nature reserve where several birds breed and rest during migration.
   i) List **TWO** characteristic features of birds. (4 marks)
   ii) Rushes found growing at *Is-Simar* are monocotyledons. Give **TWO** structural characteristics of monocots. (2 marks)
   iii) Give **ONE** structural difference between a flower in a monocot and a flower in a dicot. (2 marks)

c. The graph below shows the fluctuation of carbon dioxide in air between January and December in several years. Readings were taken between the years 1959 and 2010 in the Northern hemisphere (contains most of Earth's land).



(Source: earthobservatory.nasa.gov/Features/Carboncycle/page3.php)

Decomposition and respiration are two processes that release carbon dioxide (CO_2) in the air. These contribute to the seasonal increase of CO_2 in autumn and winter.
   i) What is decomposition? (2 marks)
   ii) Describe **ONE** human activity that increases carbon dioxide levels in the atmosphere. (2 marks)

d. i) Carbon is found in many organic molecules needed by all organisms. Name **ONE** such organic molecule found in organisms. (1 mark)
   ii) Carbon dioxide is defined as a greenhouse gas. What is a *greenhouse gas*? (2 marks)
   iii) Emissions of CFC (chlorofluorocarbons) are a major cause of the depletion of the ozone layer. Explain **TWO** effects of the thinning out of the ozone layer. (4 marks)

(Total 25 marks)

7. a. A reflex is an automatic response to a particular stimulus. It involves the conduction of impulses along neurons.
   i) Describe the action of the following components involved in producing a reflex action: sensory receptor; motor neuron and effector. (6 marks)
   ii) Reflex actions are defined as automatic actions. Explain the term automatic in relation to reflex actions. (2 marks)

b. i) One response to overheating is the release of sweat by the skin's sweat glands. Describe how sweat cools the body. (2 marks)
   ii) Apart from sweating give **ONE** other skin response to overheating. (2 marks)
   iii) Explain the function of fat in slowing down heat loss. (2 marks)

Please turn the page.

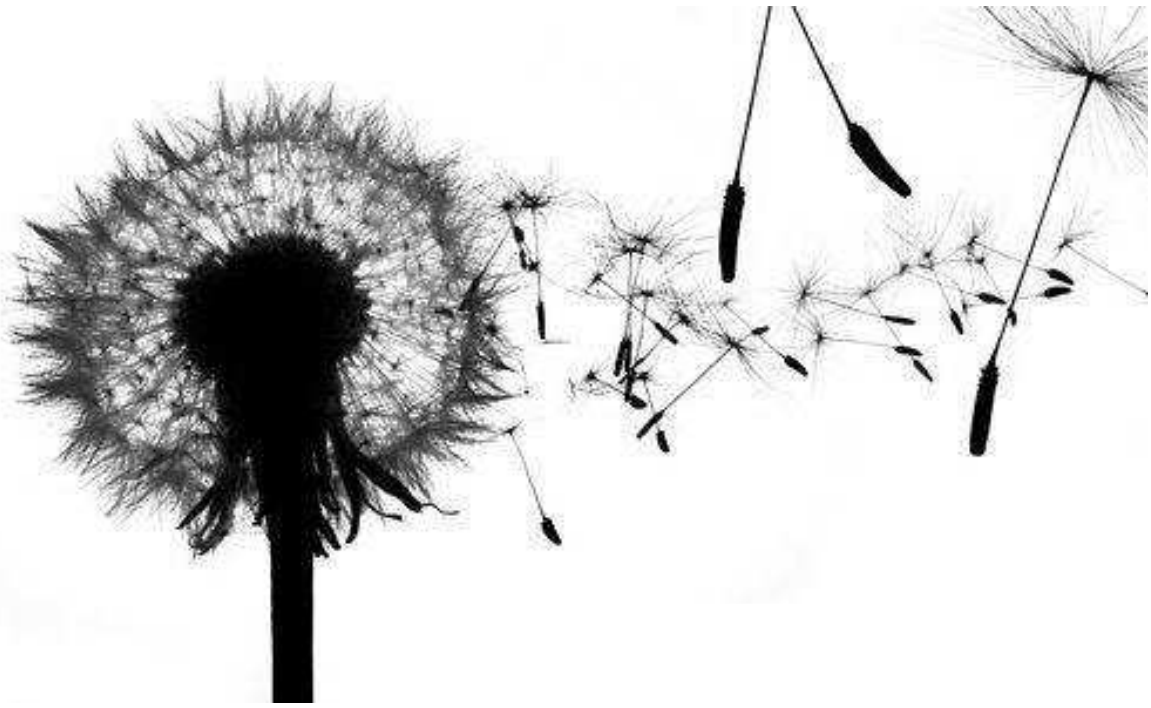
c. Plants also respond to external stimuli such as light. A pot of seedlings was put in a closed box and exposed to light coming from one side only.
   i) Describe the growth of the shoot. (2 marks)
   ii) Explain the response exhibited by the shoot. (4 marks)

d. After a few days the seedlings turned green.
   i) Name the process by which plants synthesize food. (1 mark)
   ii) Name the green pigment produced by the cells of the plant and explain its function. (4 marks)

(Total: 25 marks)

8. Describe the biological processes shown in **each** of the following pictures A to E. In your description include:
   i) the name of the process;
   ii) its characteristics;
   iii) and its biological importance.

A



(Source: http://www.sciencephoto.com/media/88375/view)
(5 marks)

B

(Source: http://images.clipartof.com/small/93476-Royalty-Free-RF-Clipart-Illustration.jpg)

(5 marks)

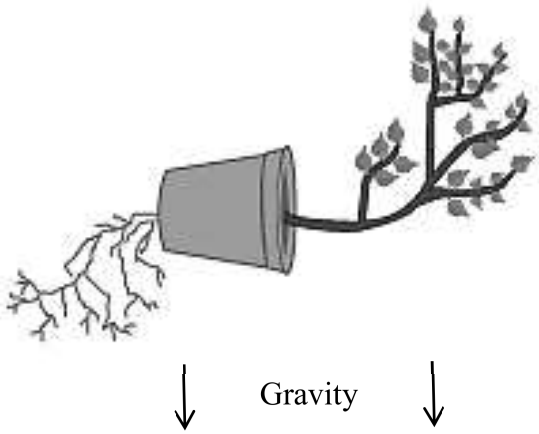
C

(Source: http://cnx.org/content/m19959/latest/graphics3.png)

(5 marks)

Please turn the page.

D



(Adapted from: http://shivangi-biology-10.2.7.2.2_SG_SS_html_104ff09b)

(6 marks)

E

(Source: http://cgo13.files.wordpress.com/2011/08/pred_prey_product.jpeg)

(4 marks)

(**Total: 25 marks**)