

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

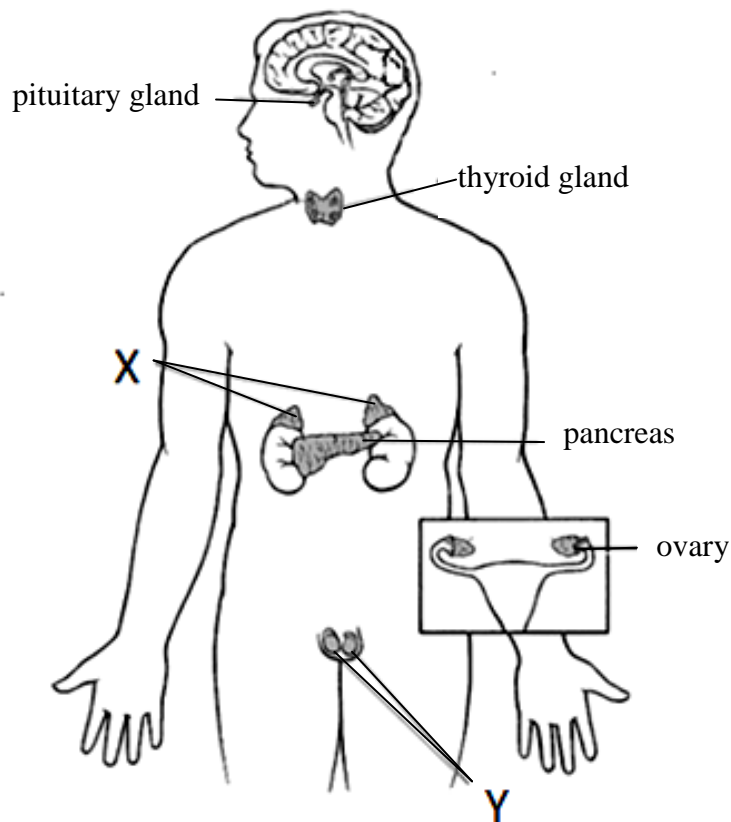
SECONDARY EDUCATION CERTIFICATE LEVEL

SEPTEMBER 2016 SESSION

SUBJECT: **Biology**
 PAPER NUMBER: I
 DATE: 29th August 2016
 TIME: 9:00 a.m. to 11:05 a.m.

ANSWER ALL QUESTIONS IN THIS PAPER IN THE SPACES PROVIDED.

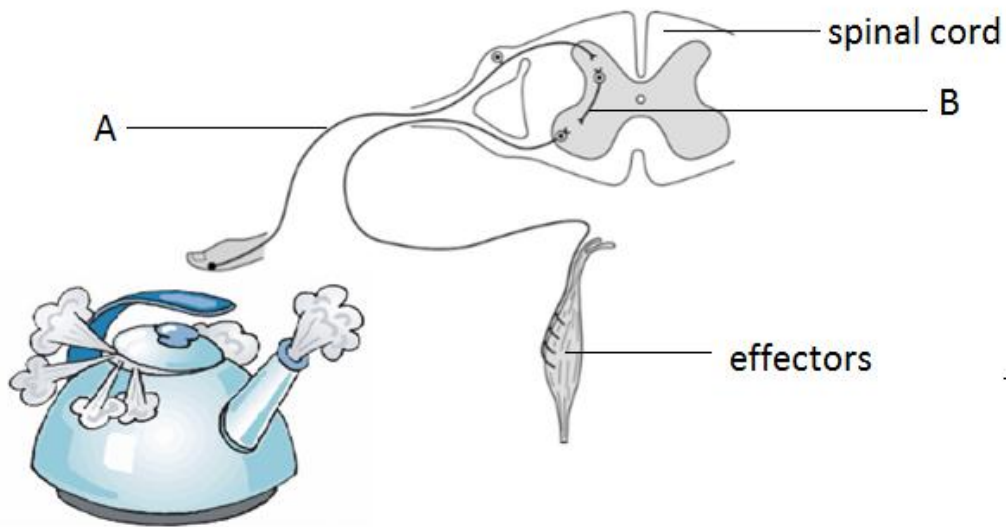
1. The diagram below shows endocrine glands in the human body.



- a. Name the endocrine glands labelled X: _____ (1 mark)
- b. Name the hormone produced by glands Y: _____ (1 mark)
- c. Explain why endocrine glands are described as 'ductless glands'.

 (2 marks)

- d. When a woman touches a hot kettle, she immediately moves her finger away from the kettle. The diagram shows the reflex action involved.



- i) Name the neurones labelled

A: _____ B: _____ (2 marks)

- ii) On the diagram, draw arrows to show the pathway of the electrical impulse that brings about a response. (1 mark)

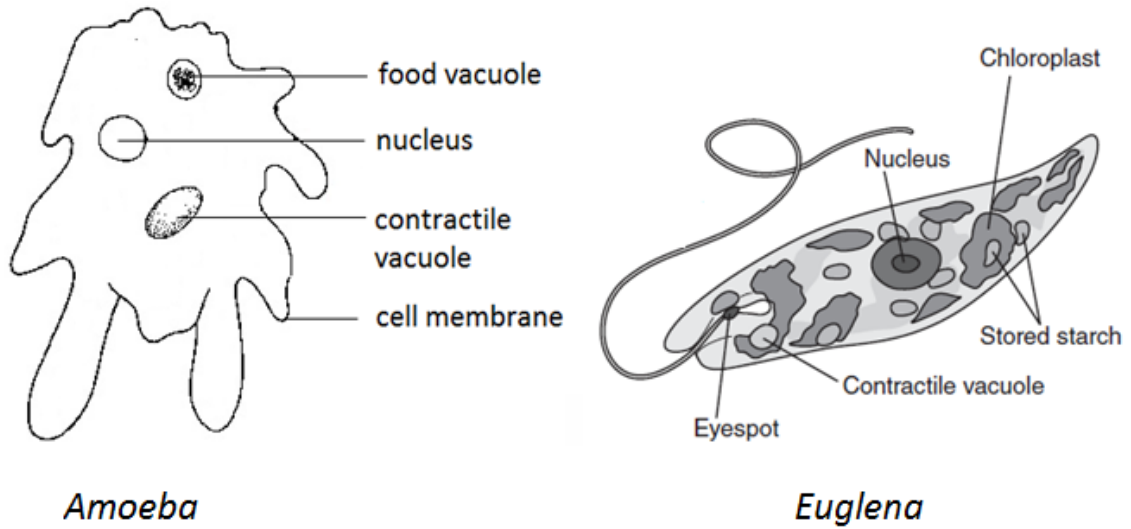
- iii) The electrical impulse travels a distance of about 1.5 m in this reflex action, at 75 m/s. Calculate the time taken for this reflex action to occur. (Show your working)

_____ (3 marks)

- iv) The spinal cord is a soft tissue made up of a bundle of nerve fibres. State ONE way how the spinal cord is protected from damage.

_____ (1 mark)
(Total: 11 marks)

2. *Amoeba* and *Euglena* are freshwater organisms.



a. Name the kingdom to which *Amoeba* and *Euglena* belong.

(1 mark)

b. Describe ONE role of the *contractile vacuole* in these organisms.

(2 marks)

c. Compare the way *Amoeba* and *Euglena*:

i) Feed;

(2 marks)

ii) Move.

(2 marks)

d. State ONE function of the following cell parts:

i) Nucleus;

(1 mark)

ii) Cell membrane.

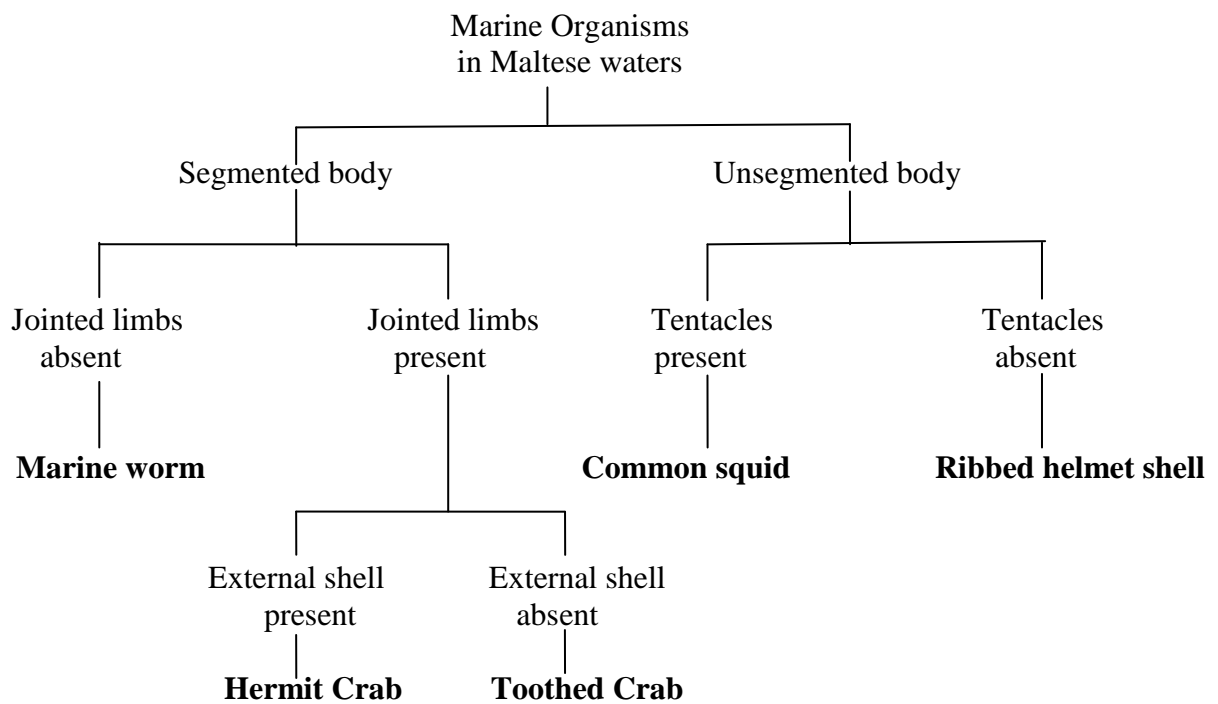
(1 mark)

e. *Amoeba* and *Euglena* are eukaryotes. Name ONE piece of evidence from the diagrams that proves this.

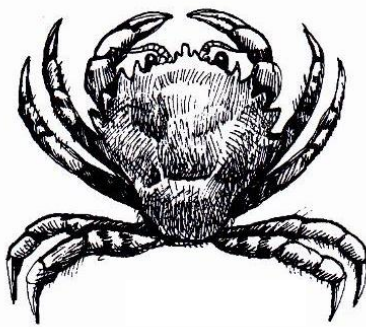
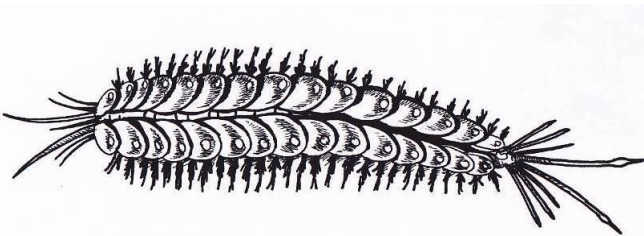

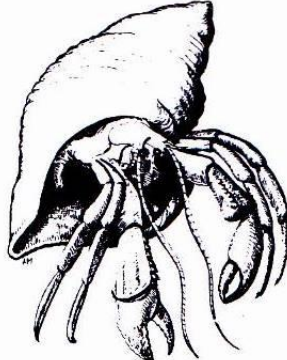
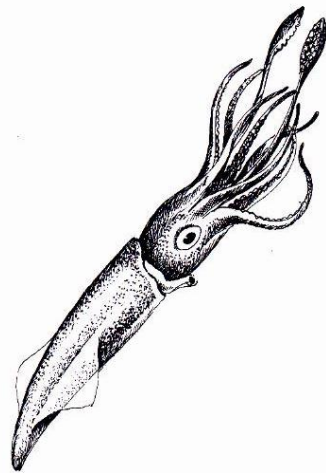
(1 mark)

(Total: 10 marks)

3. The following key is used to classify 5 animals that live in the marine environment of the Maltese Islands.



a. Use the key provided to identify each organism shown in the table:

<p>A</p>  <p>Name: _____</p>	<p>B</p>  <p>Name: _____</p>
<p>C</p>  <p>Name: _____</p>	<p>D</p>  <p>Name: _____</p>
<p>E</p>  <p>Name: _____</p>	

(*Organisms not shown to scale.)

(All diagrams from Sultana J. & Falzon V. (eds), *Wildlife of the Maltese Islands*. Birdlife Malta and Nature Trust. 2002.)

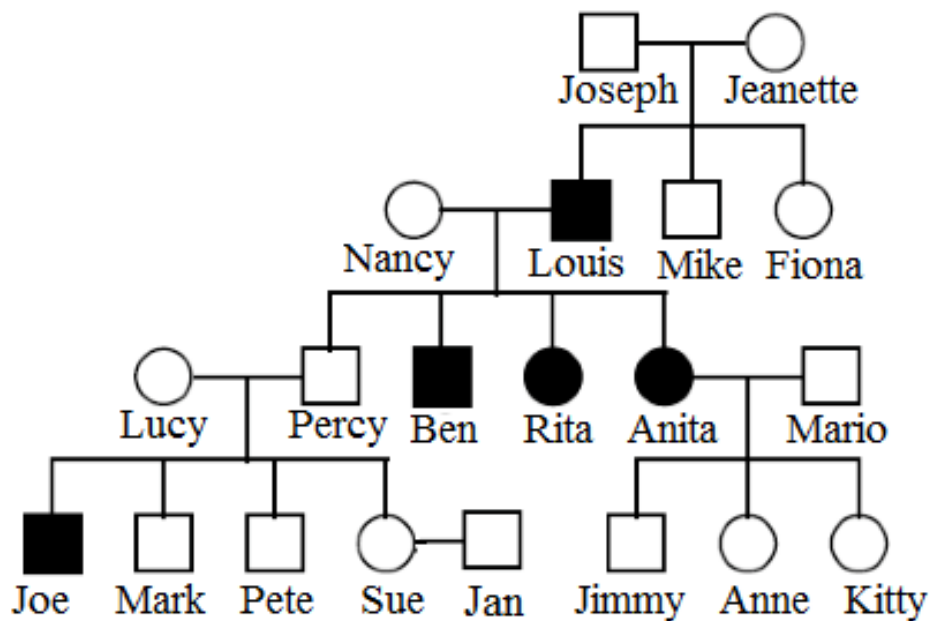
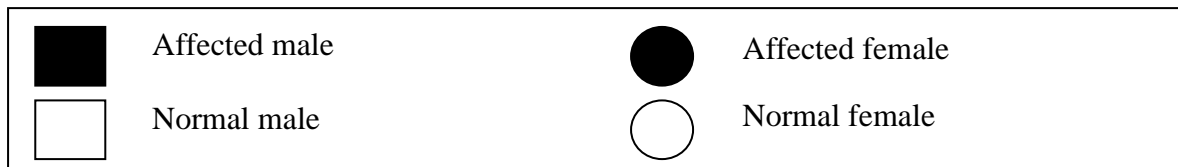
(5 marks)

b. Identify the phylum of organisms A, B, C, D and E.

Organism	Phylum
A	
B	
C	
D	
E	

(5 marks)
(Total 10 marks)

4. Harlequin ichthyosis is a genetic condition inherited in an **autosomal** recessive pattern. It is caused by a **mutation** in a gene that provides instructions for making a protein that is essential for the normal development of skin cells. Infants with this condition are born with very hard, thick skin which forms deep cracks. These skin abnormalities affect the shape of the eyelids, nose, mouth and ears, and limit movement of the arms and legs.



a. Define the following terms:

i) *mutation*;

(1 mark)

ii) *autosomal*.

(1 mark)

b. Using **H** for normal and **h** for Harlequin ichthyosis, state the genotypes of:

i) Jeanette: _____ ii) Rita: _____

(2 marks)

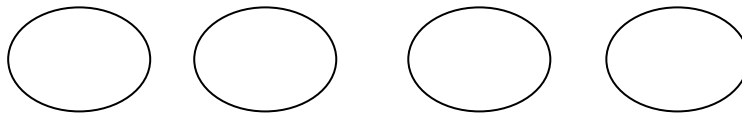
c. Doctors explain to Kitty that she is a carrier of this disease. Give ONE reason why this is true.

(2 marks)

d. Both Sue and Jan are carriers of the disease. Use the following genetic diagram to determine the probability that Sue and Jan's child will be affected by Harlequin ichthyosis.

Parents' genotype

Gamete's genotype



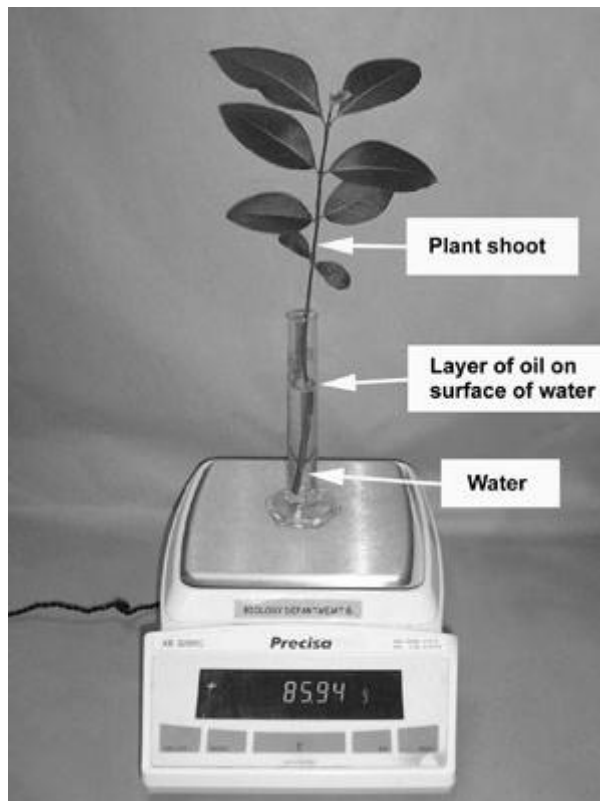
Offspring genotype

Probability of child being affected:

(4 marks)

(Total: 10 marks)

5. A group of students investigated the rate of transpiration from a plant cutting that had 8 leaves. They set up the apparatus as shown in the photograph below.



(http://www.nuffieldfoundation.org/sites/default/files/PB_estimating-rate-of-transpiration-from-a-plant-cutting.jpg)

- a. The students poured 1 ml of oil on the top of the water. Explain why.

(2 marks)

- b. The students weighed the mass of the whole set up every day for 5 days.

- i) In the table below tick (✓) the statement that best shows the observations of the students:

Statement	
The mass of the whole set up decreased every day.	
There was no change in the total mass of the whole set up after 5 days.	
The mass of the whole set up increased every day.	

(1 mark)

ii) Give a reason for your choice in b i).

(2 marks)

c. The students continued their investigation by changing the shoot. For each change listed in the table, state whether the rate of transpiration will increase or decrease. Give a reason for each answer.

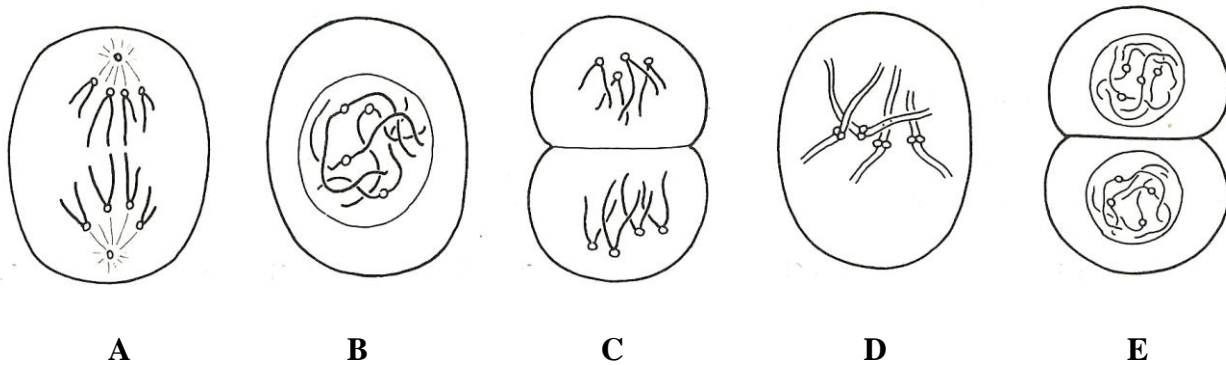
Change in set up	Increase or Decrease in rate of transpiration	Reason
Shoot is changed. The new shoot has 20 leaves.		
Shoot is changed with one from a different species. The new shoot has 8 leaves. All leaves are covered with hair.		

(4 marks)

(Total: 9 marks)

Please turn the page.

6. Drawings **A** to **E** show different stages occurring during mitosis in a cell.



a. The first stage in mitosis is shown by the stage B. Write the other letters to show the correct order in which these stages occur.

(2 marks)

b. i) How many pairs of chromosomes are present in the cell shown in the diagram in the previous page.

(1 mark)

ii) What is the diploid number of chromosomes in these cells?

(1 mark)

c. Gametes are produced by meiosis.

i) An animal has 36 chromosomes in each of its body cells. How many chromosomes will there be in one of its gametes?

(1 mark)

ii) Besides the number of chromosomes found in the daughter cells formed by meiosis, give ONE other difference between the process of meiosis and mitosis.

(1 mark)

- d. Fill in the table below to give two examples in each case of organs or tissues where one expects meiosis and mitosis to occur in animals.

Type of division	Example 1	Example 2
Mitosis		
Meiosis		

(4 marks)

(Total 10 marks)

Please turn the page.

7. Following a visit to a valley, students collected samples of soil and then analysed them in the school laboratory.
- a. The students heated 100 g of soil in an oven at 105°C for 24 hours. The mass at the end of the experiment was 70 g. Determine the percentage (%) amount of water in the soil sample. Show your working.

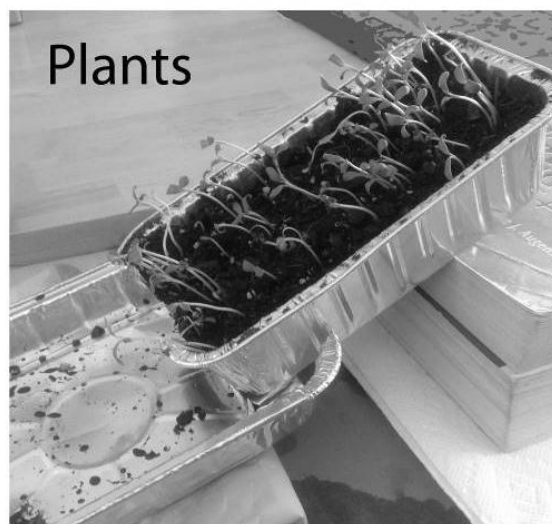
Ans: _____
(2 marks)

- b. An experiment was performed to study the effect of plants on soil erosion. Two trays were prepared as follows: Tray A was filled with 500 g of soil. Tray B was filled with 500 g of the same soil and in it 100 plant seedlings were grown for 4 weeks before the start of the experiment.

The photos below show the apparatus set-up.



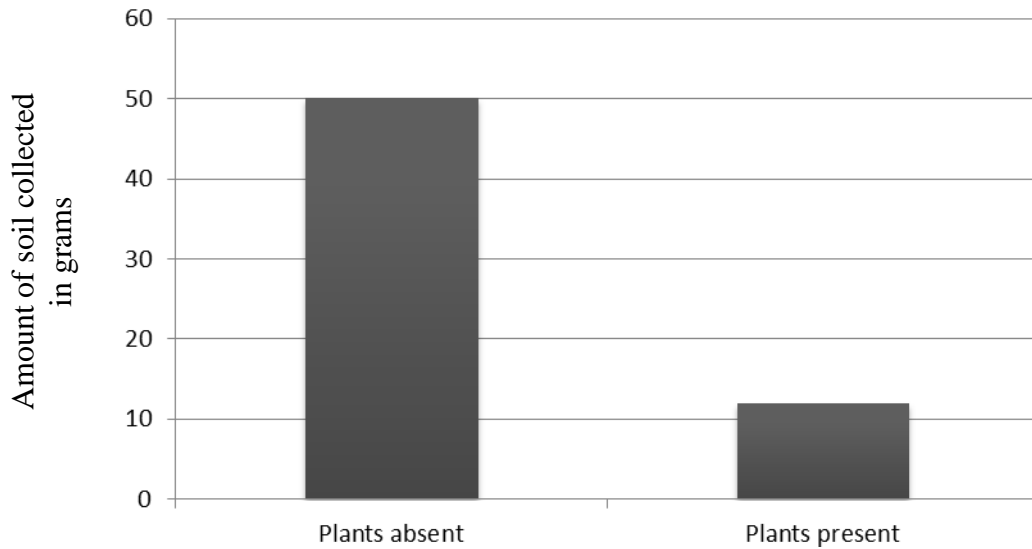
Tray A
500 g of soil
No plant seedlings



Tray B
500 g of soil
100 plant seedlings

500 ml of water were poured in each tray. The water and the soil that washed out were collected in another tray. Both the soil samples collected were dried and weighed.

The bar chart below shows the result.



Using the bar chart determine the effect of plants on soil erosion. Explain why plants affect soil in this way.

Effect: _____

Explanation: _____

(1, 2 marks)

- c. Students were asked to investigate the type of soil that earthworms prefer. They were given the following apparatus:
large plastic tray with a lid, damp loam soil, dry loam soil, 20 earthworms.

i) Describe how the apparatus may be set up for this investigation.

(2 marks)

ii) List ONE precaution that students should follow during this investigation.

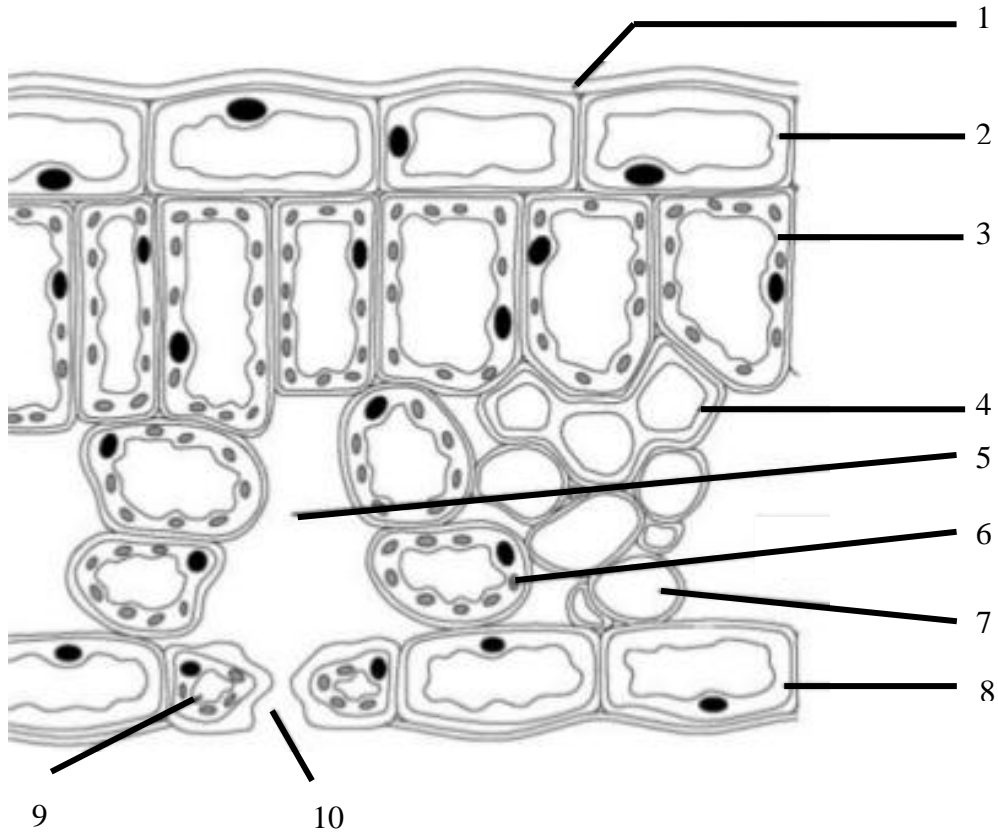
(2 marks)

iii) Describe how students will determine which soil type is preferred by the earthworms.

(2 marks)

(Total: 11 marks)

8. The following diagram shows a section through a leaf.



(<http://image.slidesharecdn.com/leafstructure-130215101940-phpapp01/95/leaf-structure-12-638.jpg?cb=1416989802>)

a. The leaf is involved in the formation of glucose inside a plant. Describe the role of cell **3** and part **10** in this process.

Cell **3**: _____

Part **10**: _____

(2 marks)

b. State ONE use of glucose in the plant itself.

(1 mark)

c. State TWO different ways in which a leaf is adapted to carry out photosynthesis.

1: _____

2: _____

(2 marks)

d. A gardener lights a gas heater in his greenhouse. List TWO ways how the gas heater may increase the rate of photosynthesis in plants growing inside the greenhouse.

1: _____

2: _____

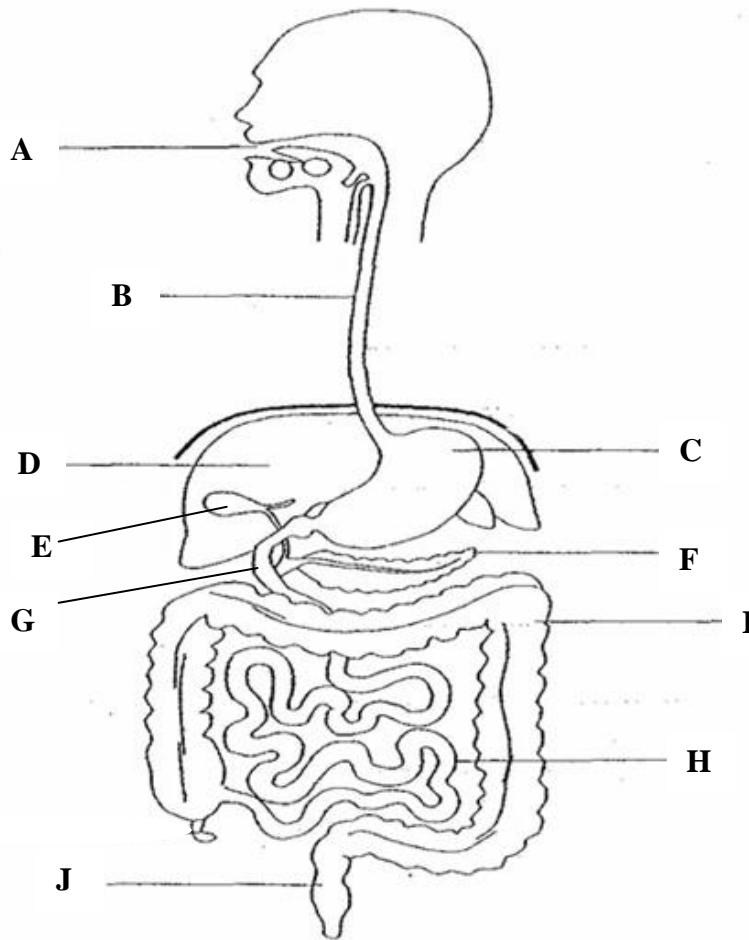
(2 marks)

e. The gardener tried increasing the light intensity in his greenhouse. He found, however, that the rate of photosynthesis would only increase up to a point and no amount of extra light would increase it further. Explain why this happened.

(2 marks)

(Total 9 marks)

9. The figure below shows the human digestive system.



(Source: <http://oldschool.com.sg/modpub/21271221134b651d6c053cb>)

a. Choose a letter from the diagram to fit each of the following descriptions.

	Description	Letter
i)	A region having an acidic pH.	
ii)	A region having an alkaline pH.	
iii)	The region where digestion of starch starts.	
iv)	The site of bile production.	
v)	The main region where food is absorbed into the bloodstream.	

(5 marks)

b. Use your knowledge of biology to explain the following statements:

i) Unless starch is digested it cannot pass into the bloodstream.

(2 marks)

ii) People whose gall bladder has been surgically removed are advised to avoid eating fats.

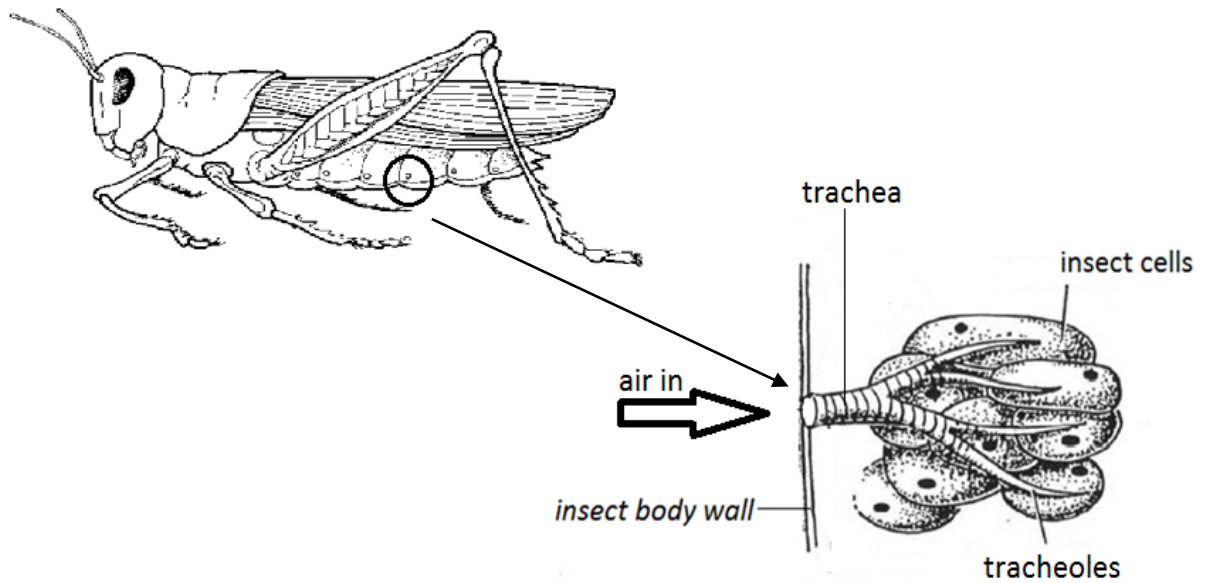
(2 marks)

iii) Some people are unable to digest lactose.

(1 mark)
(Total 10 marks)

Please turn the page.

10. The diagram below shows the breathing system in a grasshopper.



a. Tiny holes in the grasshopper's abdomen allow air into the breathing system. These are surrounded by fine hairs.

i) Name these holes.

(1 mark)

ii) State ONE function of the hairs surrounding these holes.

(2 marks)

b. The trachea is surrounded by rings of chitin. Explain why this is important.

(2 marks)

c. Explain how a large surface area for gas exchange is possible in the breathing system of an insect.

(1 mark)

- d. Like insects, humans are able to take in oxygen from the surrounding air. Fill in the table below to show what happens when humans inhale and exhale.

	Inhale air	Exhale air
Rib cage		
Intercostal muscles		
Diaphragm		
Volume in the thorax		

(4 marks)

(Total: 10 marks)

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UNIVERSITY OF MALTA, MSIDA

SECONDARY EDUCATION CERTIFICATE LEVEL

SEPTEMBER 2016 SESSION

SUBJECT:	Biology
PAPER NUMBER:	IIB
DATE:	29 th August 2016
TIME:	4:00 p.m. to 6:05 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:

- i) for question 5 of this paper you need the square paper in the booklet.*
- ii) for question 6 of this paper you need the 2 mm graph paper in the booklet.*

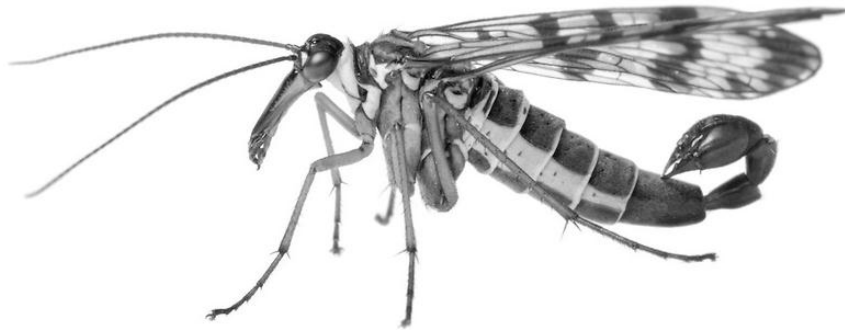
Answer any **FOUR** questions.

1. a. Human activities have led to two main problems with the Earth's atmosphere:
The greenhouse effect
Changes to the ozone layer
- i) Name **THREE** greenhouse gases. (3 marks)
 - ii) Briefly describe how greenhouse gases lead to global warming. (3 marks)
- b. i) Describe the effect of chlorofluorocarbons (CFC's) on the ozone layer. (2 marks)
- ii) List **TWO** negative effects due to the changes in the ozone layer caused by CFC's. (4 marks)
- c. Burning of fossil fuels leads to the production of soot. Describe the effect of soot on the rate of photosynthesis in plants and give a reason for your answer. (1, 2 marks)
- d. The gas sulphur dioxide is also released when fossil fuels are burnt. In the atmosphere, it dissolves in water to form a weak acid. This leads to the formation of acid rain.
- i) Suggest a pH value for acid rain. Describe how a student may determine the pH of a sample of acid rain. (1, 2 marks)
 - ii) Describe the effect that acid rain has on the leaves of plants and trees. (2 marks)
- e. Name the process that occurs when excess nitrate and/or phosphate are discharged into a river. Describe the sequence of events that occurs following the discharge. (5 marks)

(Total 25 marks)

2. Classification of organisms is partly based on external features of organisms.

a. The diagram below shows the male insect *Panorpa communis*, popularly known as the Common Scorpion fly.



(http://cdn.c.photoshelter.com/img-get/I0000_UNUWx69STY/s/880/880/AH-Common-Scorpion-Fly-male-Panorpa-communis-2229.jpg)

- i) List THREE visible characteristics that indicate that the Common Scorpion fly is an insect. (3 marks)
- ii) Give ONE disadvantage that may arise when referring to this organism with its common English name. (2 marks)

b. The picture below shows a prehistoric creature discovered in 1958 by Francis Tully, a collector of fossils. Researchers named the animal “Tully monster”. Some classified the “monster” as a shell-less snail but after further analysis of thousands of fossils, scientists have classified the animal as a fish.



(http://cdn.theatlantic.com/assets/media/img/mt/2016/03/Tullymonster/lead_960.jpg?1458057256)

- i) Name the phylum that the “Tully monster” is classified in now that it is considered to be a fish. Give ONE structural characteristic it shares with other members of this phylum. (1, 2 marks)
- ii) Give TWO characteristic structural features that could indicate that the “Tully monster” is a fish. (2 marks)
- iii) Is the “Tully monster” an ectotherm or an endotherm? (1 mark)

c. The following statements list characteristics of particular animals. These characteristics are not shared with the other animals of the group that they are classified in. For each animal, state how the listed characteristic/s is different from that of the other animals in the same group.

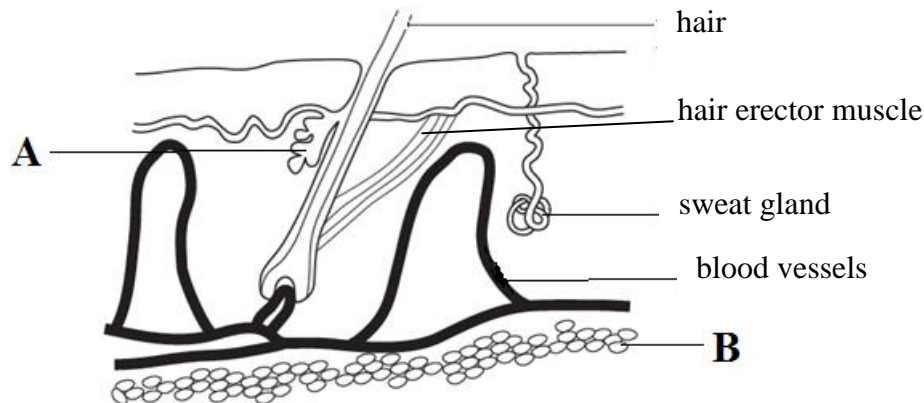
- i) The shark is a fish. It gives birth to live young. (2 marks)
- ii) The bat is a mammal. It has wings to fly. (2 marks)
- iii) The armadillo is a mammal. It has a body covered with armoured plates. (2 marks)
- iv) The platypus is a mammal. It has a duck-like beak and it lays eggs. (4 marks)

d. In March 2016, scientists reported the discovery of 2 new frog species, one in India (*Microhyla laterite*) and one in Peru (*Psychrophrynella chirihampatu*). *M. laterite* was discovered in rocky wastelands whilst *P. chirihampatu* was found in the Andes mountains.

- i) Give ONE common characteristic of the habitat of both frogs and give a reason for your answer. (2 marks)
- ii) Explain why cross breeding the two newly discovered frogs will not produce fertile offspring. (2 marks)

(Total: 25 marks)

3. The diagram shows a section through the human skin.



a. Name and state the function of the parts of the skin labelled:

- i) A; (1, 2 marks)
- ii) B. (1, 2 marks)

b. Explain how sweat glands help to lower the body temperature. (2 marks)

c. Describe the role of the hair erector muscle in controlling body temperature. (4 marks)

d. Give the biological term used to describe:

- i) Humans are organisms that keep a constant body temperature throughout the year; (1 mark)
- ii) Blood vessels get wider to release more heat in hot weather. (1 mark)

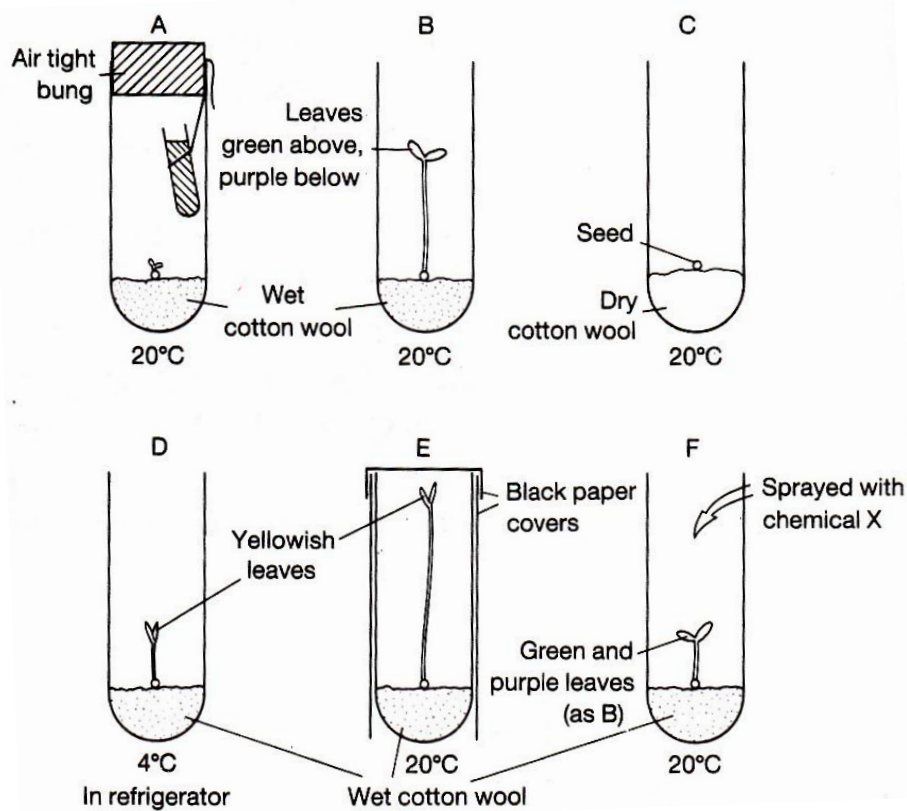
e. Describe how wearing dark thick clothes helps humans maintain a constant body temperature in cold winter days. (2 marks)

f. Give biological reasons for each of the following statements.

- i) Birds hunt for lizards mainly at dawn. Their hunting becomes less successful later in the day. (3 marks)
- ii) The Sandhill snail spends the summer months in Malta attached to the upper part of stems. (2 marks)
- iii) The antelope Jackrabbit lives in the hot desert. It has larger ears compared to the Arctic hare, which lives in extreme cold. (4 marks)

(Total: 25 marks)

4. The diagram below shows the results of an experiment to determine the effects of various treatments on the germination of mustard seeds, and their subsequent development over a period of nine days.



Ten seeds were dropped onto the cotton wool in each test tube A to F. The test tubes were placed in the following conditions:

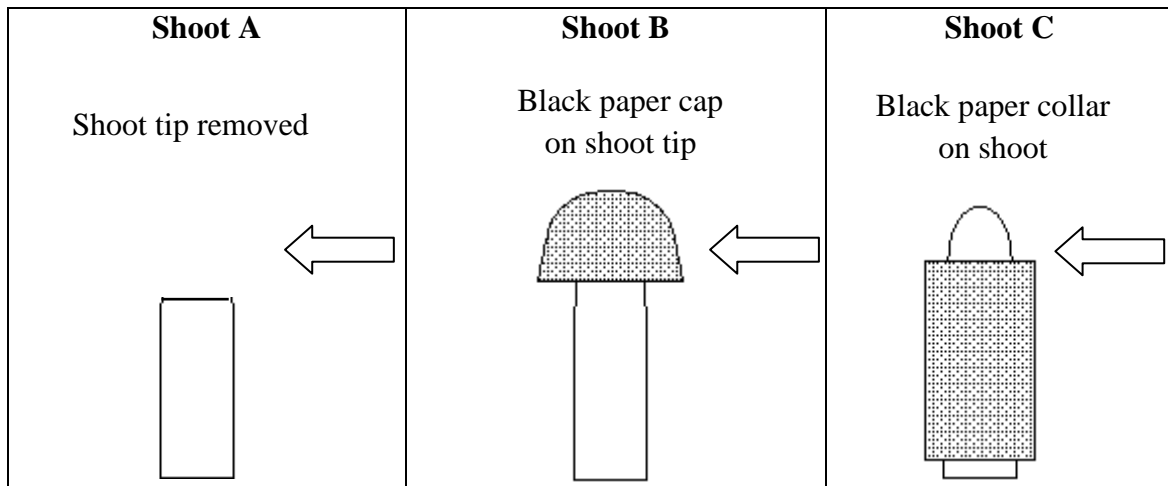
Test tube	Condition
A	On a bench by a window, in full light
B	On a bench by a window, in full light
C	In a closed cupboard
D	In a refrigerator
E	On a bench by a window, in full light
F	On a bench by a window, in full light

The seedling shown in each test tube is drawn to scale, and represents the average height of all seedlings that grew.

- From your observations of test tubes A to E only, what conclusions can be made regarding the conditions necessary for the germination of these mustard seeds? (2 marks)
- The liquid in the small tube in test tube A is pyrogallol. It is included to remove oxygen. Explain how the removal of oxygen prevents the growth of the seedling. (3 marks)
- Explain the difference in:
 - the **appearance** of the seedlings in tubes B and E; (6 marks)
 - the **size** of seedlings in tubes D and E. (3 marks)

d. A number of scientists investigated phototropism.

Three different shoots, **A**, **B** and **C** were set up to study the effect of unidirectional light on the shoot of a plant as shown in the diagram below:



= direction of light

- i) Describe the expected appearance of shoot A, B and C after a week. (3 marks)
- ii) Give a reason for each predicted appearance. (8 marks)

(Total 25 marks)

Please turn the page.

5. The diagram shows a student during fieldwork. He is using a technique called a line transect.



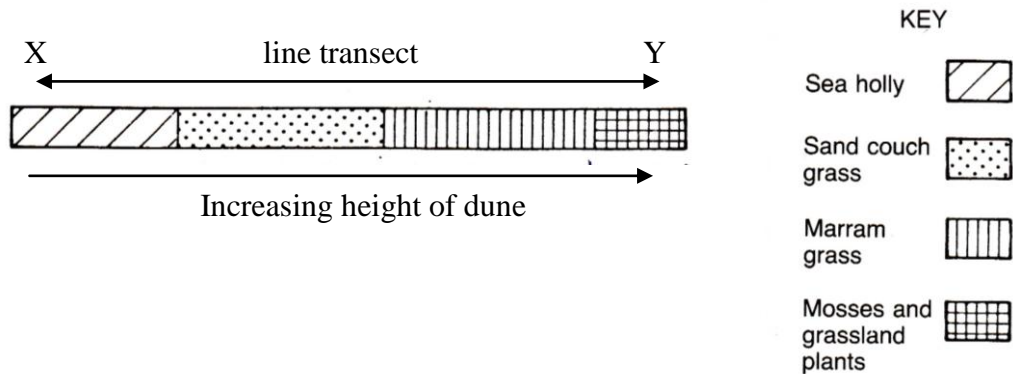
A line transect is made along a line across the habitat, by connecting a string between two vertical poles. Every organism touching the string is identified, counted and recorded on a frequency list.

During a field work exercise a group of students investigated the frequency of plants occurring at 100 points on a line transect that was placed in a field. The data is shown in the table below:

Plant	Frequency
Grass	60
Clover	10
Daisy	10
Moss	8
Dandelion	6
Plantain	6

- a. On the square paper provided, draw a bar chart to show the frequency of the different plants found on the line transect. (6 marks)
- b. The students used quadrat sampling to estimate the size of the population of dandelions in the field.
 - i) Describe a quadrat. (1 mark)
 - ii) Explain why quadrats have to be placed randomly in the field. (2 marks)
 - iii) The students also estimated the number of dandelions in another field using a large quadrat that had an area of 1 m². The total area of the field was 200 m². They placed the quadrat randomly in 10 different areas of the field and counted a total number of 25 dandelions. Using this information estimate the number of dandelions in the whole field. (4 marks)

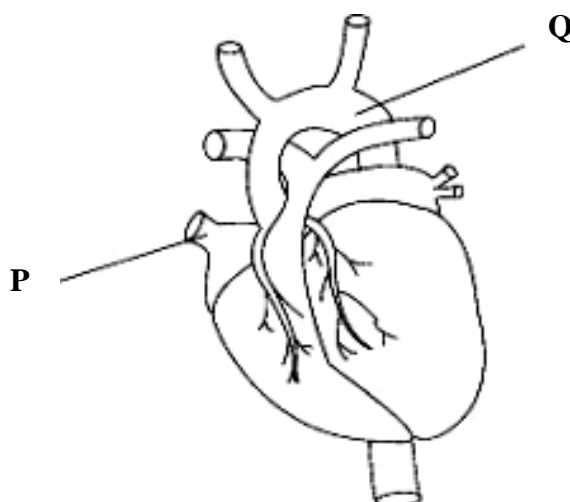
c. The diagram shows the distribution of different plants found along a line transect placed on a sand dune in a sandy beach.



- i) Describe the distribution of the plant species observed with increasing height of the dune. (2 marks)
 - ii) Sand Couch grass is a monocot. Give TWO visible characteristics of Sand Couch grass that would allow it to be classified as a monocot. (2 marks)
 - iii) The Sea Holly is a dicot. Name the phylum it is classified in and state ONE similar characteristic that it shares with other plants in this phylum. (1, 2 marks)
 - iv) Name the phylum in which mosses are classified and state TWO differences between mosses and the Sea Holly. (1, 2 marks)
 - v) Conifers were not observed along the line transect. Give ONE characteristic of a conifer plant. (2 marks)
- (Total 25 marks)**

Please turn the page.

6. The diagram below shows a ventral (front) view of the human heart.



- a. Describe the path taken by the flow of blood **through the heart** from the time it arrives at **P** to the time it leaves at **Q**. Include the name of valves, if any, found in the pathway. (5 marks)
- b. List **TWO** differences between the composition of blood in **P** and the blood in **Q**. Present your answer **in the form of a table**. (2 marks)
- c. Explain why the walls of the left ventricle and the wall of the right ventricle vary in thickness. (2 marks)
- d. In the heart of an embryo a hole is observed in the wall between the right and the left ventricle. Due to this arrangement blood flows directly from the right to the left ventricle, bypassing an important organ.
 - i) Name the organ which will be bypassed by most of the blood. (1 mark)
 - ii) State **ONE** reason for the bypass. (2 marks)
- e. The table below shows the number of deaths from heart disease, in a particular country over a period of 100 years.

Year	Number of deaths from heart disease
1890	12000
1910	26000
1930	40000
1950	60000
1970	80000
1990	92000

- i) On the graph paper provided (use the 2 mm grid scale), draw a graph to show how the number of deaths from heart disease (on y axis) varied between 1890 and 1990 (on x axis). Join the points with a straight line. (6 marks)
 - ii) Describe the pattern shown in the graph and give **TWO** reasons for the observed pattern. (2, 2 marks)
- f. Alveoli are structures in the lungs through which gaseous exchange takes place. List **THREE** changes that take place in the composition of air while it is in the alveoli. (3 marks)

(Total 25 marks)

7. Wolves were once the top predator in the Yellowstone National Park in America's. The population was completely destroyed in the 1920s, and for seventy years there were no wolves in the area. This disrupted the food chain and the ecosystem in Yellowstone National Park. In 1995, however, wolves were reintroduced to Yellowstone; this gave biologists a unique opportunity to study what happens when a top predator returns to an ecosystem.

a. Define the following terms:

- i) *Population*; (2 marks)
- ii) *ecosystem*; (2 marks)
- iii) *food chain*; (2 marks)
- iv) *predator*. (2 marks)

b. When wolves were re-introduced, they controlled the population of elks. As a result grass and trees in certain areas of the park increased and grew. This led to an increase in the number of birds. The larger number of trees also increased the number of beavers. Beavers use tree branches to build dams in the river. The dams provided new habitats for several species of invertebrates.

- i) Explain how bringing back wolves to the Yellowstone National Park resulted in an increased number of trees. (2 marks)
- ii) Give TWO reasons why an increased number of trees led to an increased number of birds. (2 marks)
- iii) Explain why the dams in the river (built by the beavers) eventually lead to an increase in the number of fish in the river. (2 marks)

c. The wolves also killed coyotes and so the number of small herbivores such as rabbits in the area increased. As a result the number of birds of prey in Yellowstone National Park also increased.

- i) From the information above, identify the animals that are eaten by both the coyotes and the birds of prey. (1 mark)
- ii) Are coyotes carnivores or herbivores? Give a reason for your answer. (2 marks)
- iii) Explain how killing the coyotes lead to a greater number of birds of prey in Yellowstone. (2 marks)

d. Using the information above draw a simple food web to show the feeding relationships between the following organisms found in Yellowstone National Park:

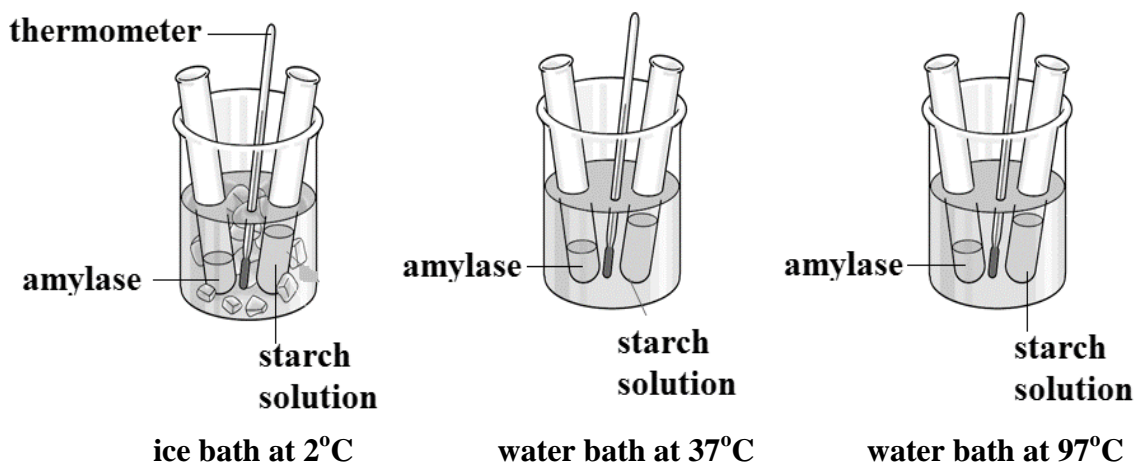
Grass, elks, wolves, coyotes, birds of prey, rabbits.

(6 marks)

(Total 25 marks)

Please turn the page.

8. Students carried out an experiment to investigate the effect of temperature on the action of the enzyme amylase. 1 cm³ amylase and 10 cm³ of starch solution were placed in each of three water baths at 2°C, 37°C and 97°C, as shown in the diagram below.



After 10 minutes, the starch solution was added to the amylase. At 30 second intervals, one drop of the mixture was added to two drops of Iodine solution in the wells of the spotting tile, as shown in the diagram below. Students observed any colour changes and presented their results in a table.

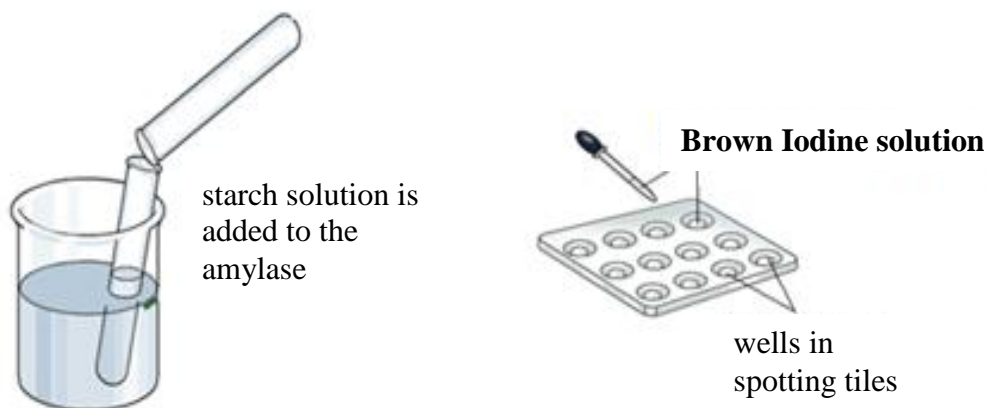


Table of results:

Colour change after... (seconds)	Ice bath at 2°C	Water bath at 37°C	Water bath at 97°C
30	Blue black	Blue black	Test was not performed
60	Blue black	Blue black	
90	Blue black	Very dark brown	
120	Blue black	Brown	
150	Blue black	Brown	
180	Blue black	Brown	
210	Blue black	Brown	
240	Blue black	Brown	

- a. Why was it necessary to leave both test tubes under each condition for 10 minutes before mixing the starch and amylase? (2 marks)
- b. Explain why:
- i) When testing the solution in the ice bath at 2°C with iodine solution, a blue black colour was always observed; (3 marks)
 - ii) After 2 minutes, students observed a brown colour when the solution in the water bath at 37°C was added to Iodine. (3 marks)
- c. Students did not manage to test the solution in the water bath at 97°C with iodine solution. Predict the colour that would be observed after 30 s, 120 s and 240 s. (1 mark)
- d. Amylase is an enzyme.
- i) Define the term *enzyme*. (2 marks)
 - ii) Name TWO parts of the digestive system that produce amylase, and state the optimum pH for each enzyme to work. (2, 2 marks)
- e. Enzymes work using the lock and key theory. Use labelled diagrams to explain this theory. Use the following words to label your diagram: *enzyme*, *products*, *enzyme-substrate complex*, *substrate*. (6 marks)
- f. i) The building blocks of enzymes are amino acids. Name the elements making up proteins. (2 marks)
- ii) State ONE function of proteins in a balanced diet. (2 marks)

(Total: 25 marks)