

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

**SECONDARY EDUCATION CERTIFICATE LEVEL**

**MAY 2017 SESSION**

SUBJECT:	<b>Biology</b>
PAPER NUMBER:	I
DATE:	8 <sup>th</sup> May 2017
TIME:	4:00 p.m. to 6:05 p.m.

**ANSWER ALL QUESTIONS IN THIS PAPER IN THE SPACES PROVIDED.**

1. The table below contains incomplete biological statements. Complete each statement by writing the correct number in the box. The first statement has been completed for you.

	Statement	Number
a.	The number of bronchi in the human respiratory system is	2
b.	The number of ventricles in the human heart is	
c.	The number of different elements in a fat molecule is	
d.	The number of hydrogen atoms in glucose is	
e.	The number of waste products of human anaerobic respiration is	
f.	The number of chromosomes in red blood cells is	
g.	The number of trophic levels in a food chain that ends with a tertiary consumer is	
h.	The number of cells produced after a zygote divides four times by mitosis is	
i.	The number of ova released by the ovary which results in identical twins is	
j.	The number of the different types of blood groups is	
k.	The number of cotyledons in the seed of a monocotyledon is	

(1 each)

**(Total: 10 marks)**

2.

a. In the table below write the name of the part of the cell that corresponds to each of the following descriptions:

Description	Part of cell
Regulates entry and exit of materials into and out of the cell	
Controls all the cell's activities	
Contains cell sap	
The site where most of the cell's chemical reactions take place	

(4)

b. Water is taken in by the roots of flowering plants. The water then travels up the stem and passes out through the leaves.

i) In the space provided, draw and label a root hair cell. Its function is to take up water from the surrounding soil.

(3)

ii) Give the feature that root hair cells have so that they take up water more efficiently.

(1)

iii) Name **ONE** organelle that is present in a palisade cell but absent in a root hair cell.

(1)

c. Figure 2 shows cells that line the inside surface of the nose and trachea.

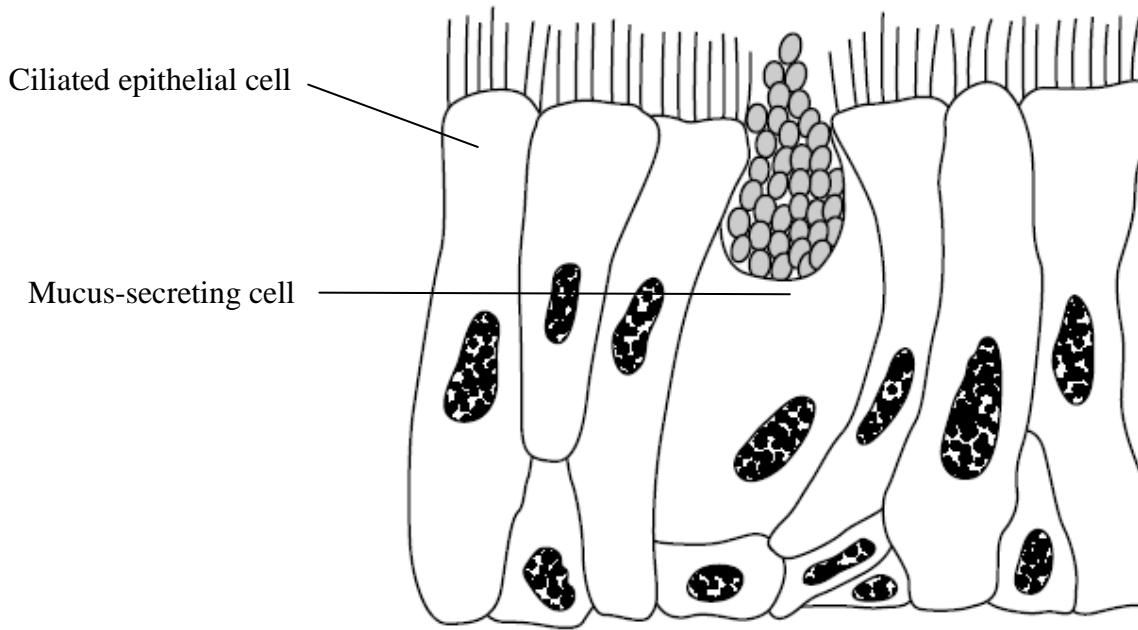


Figure 2: Cells of ciliated epithelium lining the nose and the trachea

Describe how each type of cell helps to keep the lungs clean:

i) mucus-secreting cell;

\_\_\_\_\_ (1)

ii) ciliated epithelial cell.

\_\_\_\_\_ (1)

**(Total: 11 marks)**

*Please turn the page.*

3. Figure 3.1 below shows part of the human digestive system.

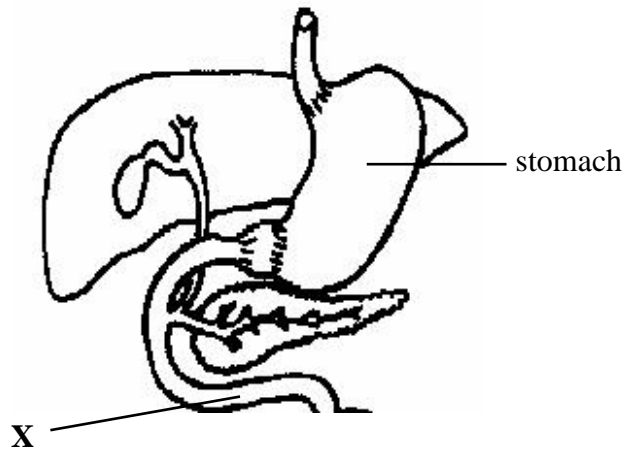


Figure 3.1: Part of the human digestive system

a. Fat molecules form an important part of the human diet. They are digested in the alimentary canal by the enzyme lipase.  
Name and label the organ shown in Figure 3.1, which produces the enzyme lipase.

(2)

b. Digestion of fat is very slow without lipase. It would be even slower in the absence of an additional substance produced by another organ also shown in Figure 3.1.

i) The substance released: \_\_\_\_\_

ii) The organ that secretes it: \_\_\_\_\_

iii) The organ where it is stored before it is released: \_\_\_\_\_ (3)

c. Figure 3.2 shows the action played by the secretion mentioned in part b i) in the digestion of fats.

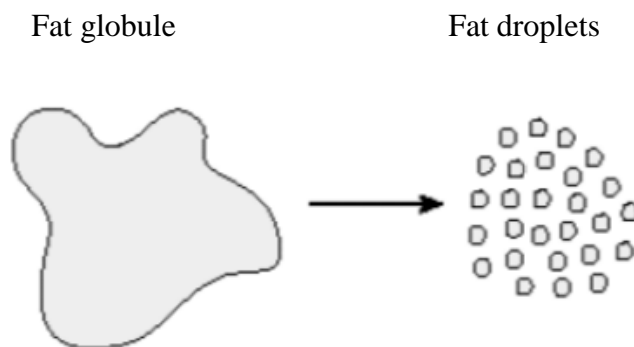


Figure 3.2: Action on fat globule during digestion of fat

- 
- i) Name the process shown in Figure 3.2 and explain how it helps to increase the rate at which lipase breaks down fats.

Process: \_\_\_\_\_

Explanation: \_\_\_\_\_

\_\_\_\_\_ (2)

- ii) Describe the action of the enzyme lipase on fat molecules.

\_\_\_\_\_

\_\_\_\_\_ (2)

- d. Describe how the partially digested food moves along structure X, shown in Figure 3.1.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (2)

**(Total: 11 marks)**

*Please turn the page.*

4. The photomicrograph below shows a vascular bundle from a dicotyledonous root.

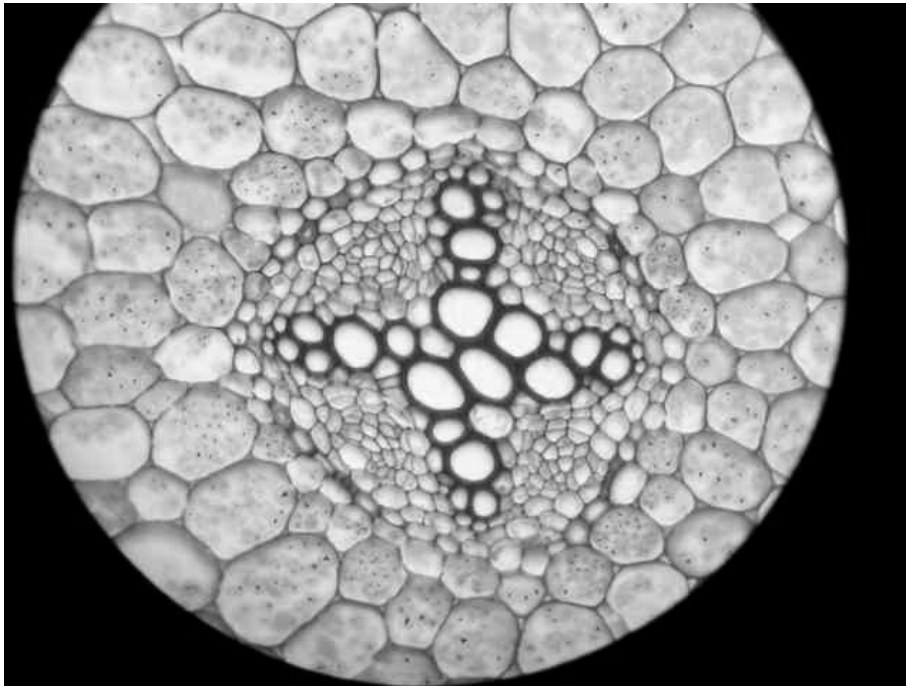


Figure 4.1: Photomicrograph showing a vascular bundle in a root  
<http://iws.collin.edu/jbeck/PlantstructureHtml/Dicotroot40x.jpg>

- a. i) On the photomicrograph in Figure 4.1, label the xylem tissue. (1)
- iii) Water travels up the stem of a plant in the xylem. State **ONE** other function of xylem tissue in plants.

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(1)

- b. List **ONE** feature of the cells making up xylem which help water travel up the stem.

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(1)

c. Bark ringing is the process when a ring of bark is removed from a tree. In the process, the tissue that transports sugar in the plant is removed as shown in Figure 4.2.

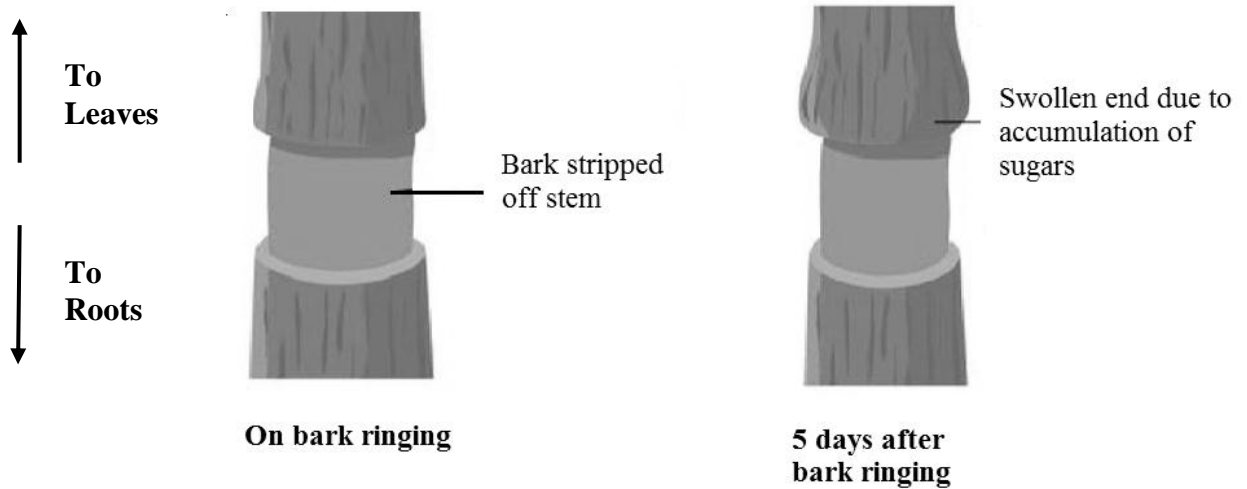


Figure 4.2: Investigation of bark ringing  
[http://images.slideplayer.com/39/10931322/slides/slide\\_9.jpg](http://images.slideplayer.com/39/10931322/slides/slide_9.jpg)

i) Name the tissue that has been removed with the bark.

\_\_\_\_\_ (1)

ii) Name the organ where sugars are formed in the plant and name the process of synthesis of sugars.

Organ: \_\_\_\_\_

Process: \_\_\_\_\_ (2)

ii) Explain why the majority of trees will die when a ring of bark is removed.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (3)

**(Total: 9 marks)**

*Please turn the page.*

5. Three broad bean seeds were tied at different places on a transparent glass slide as shown in Figure 5.1 below. The glass slide was placed in a beaker of water such that the middle broad bean just touched the water. The setup was left for 7 days.

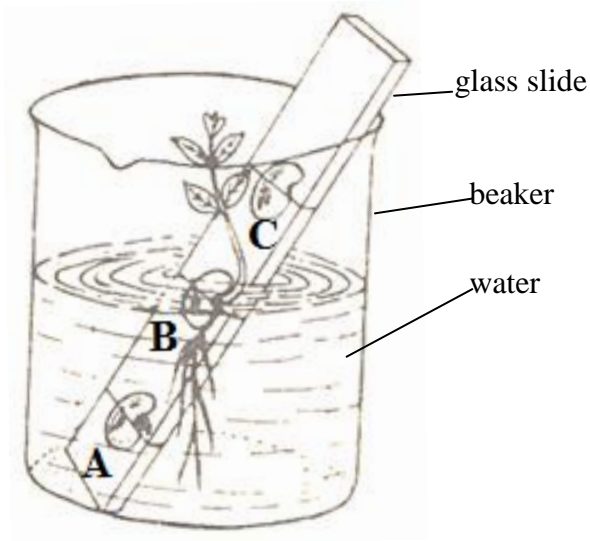


Figure 5.1: Apparatus to investigate germination in three broad bean seeds

- a. Give **ONE** reason why seeds A and C did not germinate.

Seed A: \_\_\_\_\_

Seed C: \_\_\_\_\_ (2)

- b. The graph below shows the change in dry mass of the germinating seed and the cotyledons.

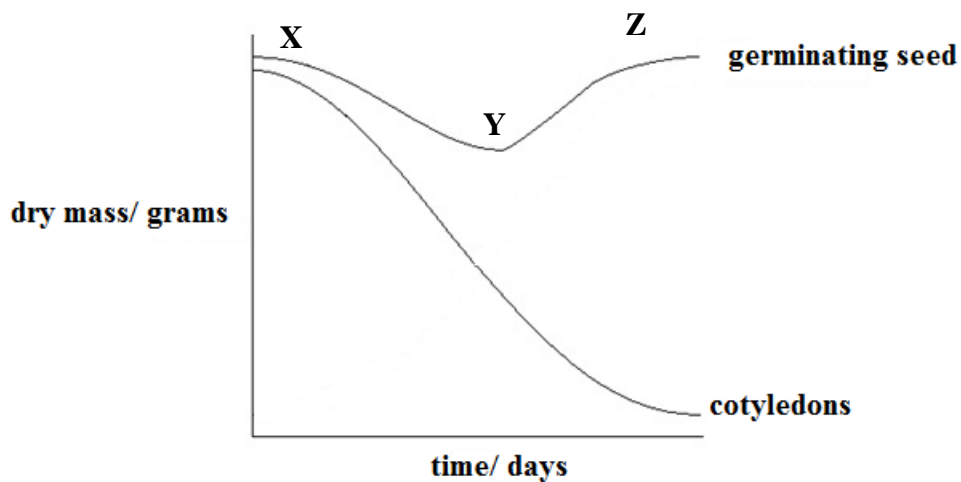


Figure 5.2: Change in dry mass of the germinating seed and the cotyledons



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Explain, giving biological reasons, what happens to the dry mass of the germinating seed in the following regions shown on the graph:

i) between points X and Y;

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(2)

ii) between points Y and Z.

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(2)

c. The mass of the cotyledons decreased drastically after a few days.

i) Name the carbohydrate stored in the cotyledons.

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(1)

ii) Describe a test to show the presence of the carbohydrate stored in cotyledons.

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(2)

**(Total: 9 marks)**

*Please turn the page.*

6. Figure 6.1 shows four arthropods.

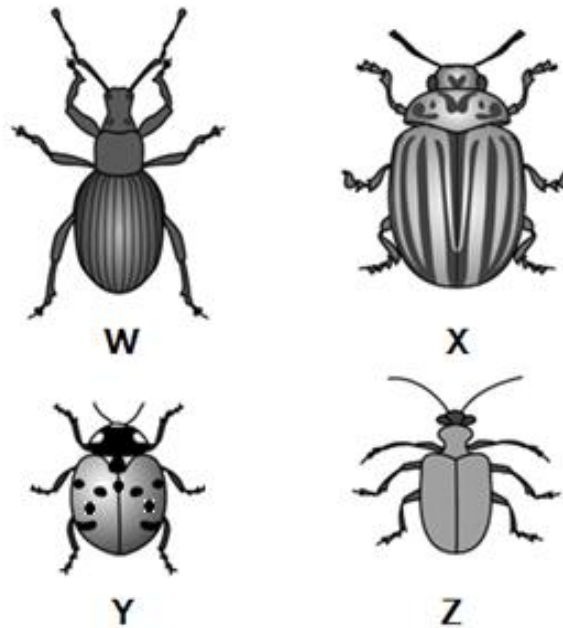


Figure 6.1: Four arthropods

a. State **ONE** characteristic that is common to all arthropods.

(1)

b. Use the dichotomous key below to name arthropod W and Z.

Key	Name of Arthropod
1. Body has no stripes	Go to 2
Body has stripes	Go to 3
2. Antennae are longer than width of head	<i>Lilioceris cheni</i>
Antennae are shorter than width of head	<i>Coccinella septempunctata</i>
3. Head is wide and rounded	<i>Leptinotarsa decemlineata</i>
Head is long and narrow	<i>Otiorhynchus sulcatus</i>

W: \_\_\_\_\_ Z: \_\_\_\_\_ (2)

c. Give the species name of arthropod Y.

(1)

d. Name the class to which organisms W, X, Y and Z belong to and state **TWO** characteristics, visible in the diagram that are common to this class.

Class: \_\_\_\_\_

Characteristic 1: \_\_\_\_\_

Characteristic 2: \_\_\_\_\_ (3)

e. Figure 6.2 shows a whitefly. Whiteflies live on the underside of plant leaves. They inject their mouth parts in the plant leaves and suck sugars. They suck more sugars than they can digest and they excrete the excess as a sweet, sticky substance called honeydew. Black fungus grows and feeds on the honeydew, thus covering the leaf.



Figure 6.2: A whitefly

i) Give the biological term that describes the movement of sugars from the leaves to other parts of the plant.

\_\_\_\_\_ (1)

ii) Explain how black fungus growing on leaves can harm the plant.

\_\_\_\_\_  
 \_\_\_\_\_ (2)

iii) Organism Y is often introduced in fields to eat whitefly. Name this mechanism and state **ONE** advantage of it.

Name: \_\_\_\_\_

Advantage: \_\_\_\_\_ (2)

iv) Whiteflies lay tiny oblong eggs which hatch into young whiteflies which increase in size through four nymphal stages called instars. Name this type of metamorphosis.

\_\_\_\_\_ (1)

**(Total: 13 marks)**

7.

a. The table below lists some features of the five groups of living organisms.

Use the terms **YES**, **NO** or **SOME** to complete the table. Some answers have been included.

Group	Can photosynthesise	Have cell walls	Produce seeds	Are decomposers
Plants				<i>no</i>
Animals				<i>some</i>
Fungi	<i>no</i>			
Bacteria	<i>some</i>			
Viruses		<i>no</i>		

(5)

b. The following two statements are incorrect. Write the correct statement and give **ONE** reason for your answer.

- i) Although biologists believe that deforestation is harmful to planet Earth, it can improve the fertility of the soil in the deforested area.

Correct statement: \_\_\_\_\_

\_\_\_\_\_

Reason: \_\_\_\_\_

\_\_\_\_\_ (2)

- ii) In fish farming, persistent pesticides, not harmful to the farmed fish, are added to the cages to kill disease-causing organisms. Live shellfish, such as mussels, found living close to the fish farm are not found to contain any pesticide.

Correct statement: \_\_\_\_\_

\_\_\_\_\_

Reason: \_\_\_\_\_

\_\_\_\_\_ (2)

**(Total: 9 marks)**

8.

- a. Students in a Biology class wanted to investigate if huddling, i.e. when a group of animals stay close to each other reduces temperature loss. They prepared two sets of apparatus: a group of seven test-tubes with one thermometer in the middle test-tube and another thermometer in an outer test tube and a single test tube with a thermometer. They added hot water to all the test tubes and took temperature readings for 10 minutes every minute. The set-up is shown below.

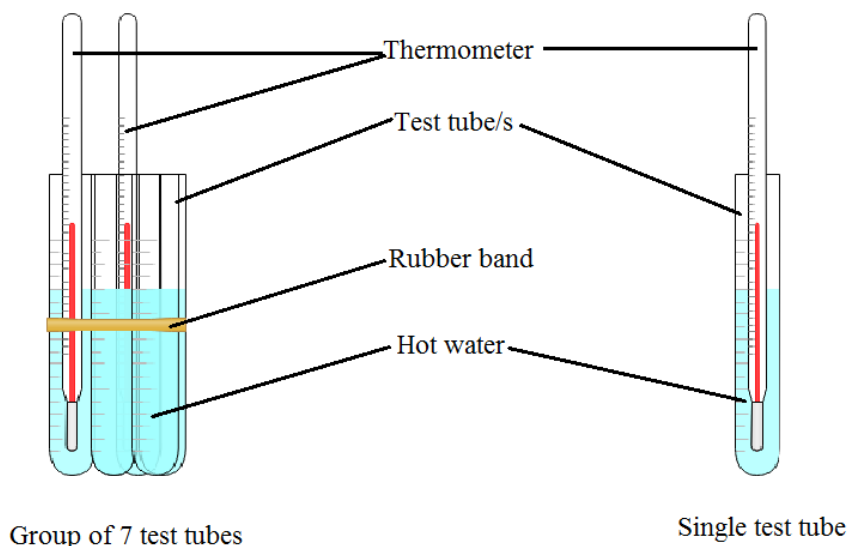


Figure 8.1: Apparatus to investigate the effect of huddling on heat loss

- i) The students found the total surface area of each apparatus set up. The following are the results obtained.

Test tube/s	Total surface area (cm <sup>2</sup> )
7 test tube group	367.5
Single test tube	103.5

In the space below, work out the average surface area per test-tube for the setup containing 7 test tubes.

Answer: \_\_\_\_\_ (2)

*This question continues on the next page.*

- ii) In the table below, compare the expected change in temperature in each of the test tubes by using the following terms: **large decrease in temperature**; **medium decrease in temperature** and **small decrease in temperature**.

Each term may be used once, more than once or not at all.

<b>Thermometer</b>	<b>Temperature change</b>
Thermometer placed in the outer test tube in the setup with a group of 7 test tubes	
Thermometer placed in the inner test tube in the setup with a group of 7 test tubes	
Thermometer in setup with a single test tube	

(3)

- iii) Give **ONE** reason for each answer given in part a ii).

<b>Thermometer</b>	<b>Reason</b>
Thermometer placed in the outer test tube in the setup with a group of 7 test tubes.	
Thermometer placed in the inner test tube in the setup with a group of 7 test tubes.	
Thermometer in setup with a single test tube.	

(3)

- b. The photograph below shows Ankole-Watusi cattle native to Africa. These cattle have elongated horns that can reach up to 2.4 m wide. The interior of the horns have a network of bone that carries blood vessels to the outer surface of the horn. The Ankole-Watusi cattle typically live in warm climates.



Figure 8.2: [https://c2.staticflickr.com/6/5151/7111672751\\_9f139be708\\_b.jpg](https://c2.staticflickr.com/6/5151/7111672751_9f139be708_b.jpg)

Explain, with reference to thermoregulation, the biological importance of blood vessels within the large horns.

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(2)

**(Total: 10 marks)**

*Please turn the page.*

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9. Give **TWO** reasons to suggest why each of the following initiatives have been promoted as 'beneficial to the environment.'

a. People who buy a new electric car get more money for their old car than those who buy a new car that runs on fuel.

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(2)

b. A company in USA is packing water in carton boxes instead of plastic bottles.

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(2)

c. The LifeMedGreenRoof project promotes the setting up of roof gardens in Malta.

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(2)

d. WasteServ Malta has introduced the separation and collection of organic waste in a number of localities.

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(2)



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- e. In the past years, different areas in Malta such as Il-Majjistral National Park and Inwadar National Park were designated as conservation areas.

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(2)

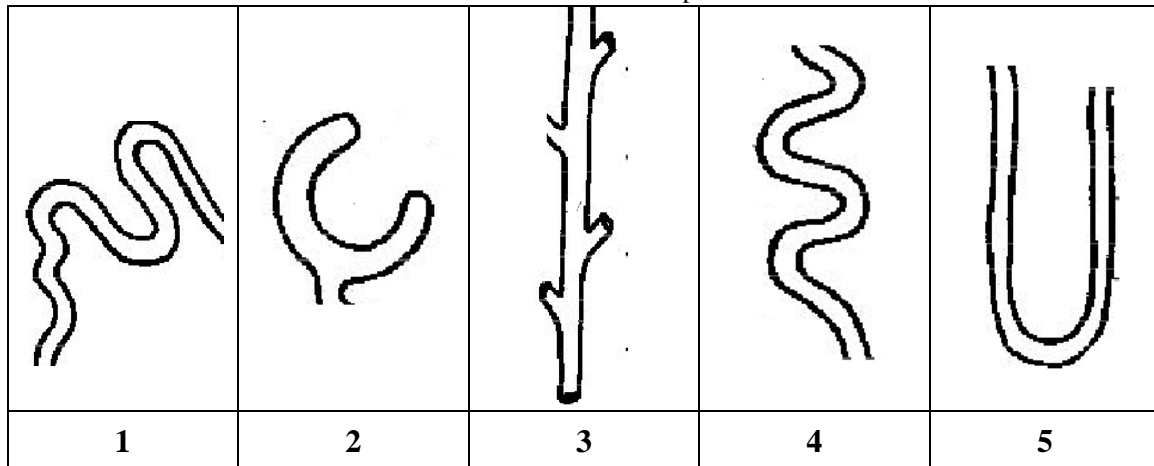
**(Total: 10 marks)**

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10. The nephron is a functional unit of the kidney. One of its functions is to regulate the concentration of water and salts in blood.

a. The figures in the tables show parts of the nephron.

Table 10.1: Parts of a nephron



Fill in the missing numbers to show the correct order of each part shown above in a nephron.

	4		1	
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(1)

b. The following table shows the change in the concentration of components in the blood plasma, filtrate and urine.

Table 10.2: Blood components in plasma, filtrate and urine

Blood component	Plasma (g/100 cm <sup>3</sup> )	Filtrate (g/100 cm <sup>3</sup> )	Urine (g/100 cm <sup>3</sup> )
Water	90.00	98.00	98.00
Mineral salts	0.72	0.72	1.10
Albumin	8.00	0.00	0.00
Glucose	0.10	0.10	0.00
Urea	0.05	0.05	1.80

Using your biological knowledge and the information in the table above, explain why:

i) Mineral salts and glucose are present in the filtrate, but albumin is not.

(2)

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ii) Glucose is present in the filtrate but not in urine.

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(2)

iii) The concentration of mineral salts and urea is higher in urine than in blood plasma.

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(2)

c. Name the region of the nephron where ADH causes the reabsorption of water.

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(1)

**(Total: 8 marks)**

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UNIVERSITY OF MALTA, MSIDA

## SECONDARY EDUCATION CERTIFICATE LEVEL

## MAY 2017 SESSION

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SUBJECT:	<b>Biology</b>
PAPER NUMBER:	IIA
DATE:	9 <sup>th</sup> May 2017
TIME:	4:00 p.m. to 6:05 p.m.

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**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.**

**Researching Vibriosis – a disease in farmed fish**

One of the main problems in fish farming of marine fish is the disease called Vibriosis. It is called so as it is caused by a genus of bacteria called *Vibrio*. The processes in fish farms lead to stressful conditions for the fish. These include changes in salinity, changes in temperature, handling and transportation, accumulation of waste and overcrowding. All these factors have an effect on the physiology of fish and make them more prone to infection by *Vibrio*.

This disease is very common in *Sparus aurata* (gilthead sea bream in English, awrata in Maltese). Although this species is the most commonly farmed marine finfish species in the Mediterranean, it is easily infected by *Vibrio harveyi* when compared to other more commonly farmed marine finfish. Although Vibriosis is generally treated by antibiotics; *Vibrio harveyi* is becoming antibiotic resistant. Thus further research is going on to look into alternative methods of preventing and controlling the bacterium.

This research involves the product TEX-OE® which is extracted from the outer skin of the prickly pear, *Opuntia ficus-indica* (bajtar tax-xewk). TEX-OE® accelerates the production of heat shock proteins (HSPs) inside cells. These proteins are normally produced when cells are under stressful conditions. HSP's help the cell to repair vital proteins and ensures that it continues to produce new proteins. So if HSP's are present in the fish before it is infected by *Vibrio harveyi*, the fish will kill the bacterium faster and suffer less damage.

In this study, the scientist tried to establish the pattern of growth of *Vibrio harveyi* at 20 °C, 30 °C and 37 °C using a turbidimetry method. This method involves passing light through the flask where bacteria are grown. The greater the number of bacteria, the less light will pass through. The experiment was performed twice. First the bacteria were grown in the absence of TEX-OE® and then in the presence of TEX-OE®. The results showed that TEX-OE® had no effect on the growth of the bacterium. These results confirmed that TEX-OE® does not directly decrease the rate of growth of the bacterium *Vibrio harveyi*.

*(Adapted from Walker L., Studies on the effects of Tex-OE® on microbial physiology and pathogenicity; in Biology Symposium Abstracts 2015, UOM)*

- a. Give **TWO** differences between a cell extracted from *Sparus aurata*, and a cell of the bacterium *Vibrio*. (2)
- b. List **TWO** differences between a cell extracted from *Sparus aurata* and a cell extracted from *Opuntia ficus-indica*. (2)
- c. Name **ONE** cellular structure that is present in **all** of the following: the bacterium *Vibrio*, in a cell extracted from *Sparus aurata* and a cell extracted from *Opuntia ficus-indica*. (1)
- d. Name the phylum that *Sparus aurata* is classified in. Give **ONE** characteristic structural feature of all organisms belonging to this phylum. (2)
- e. List **TWO** characteristics that may be used to distinguish *Sparus aurata* from other fish. (2)
- f. Explain how an increase in salinity would have a stressful effect on fish. (2)
- g. At which of the three temperatures used in the experiment is the greater number of bacteria observed? Give **ONE** reason for your answer. (2)

**(Total: 13 marks)**

2. Green plants contain different pigments that absorb light at different wavelengths. The results below indicate the light absorbed by chlorophyll and the rate of photosynthesis over this range of wavelengths.

Table 2: % of light absorbed by chlorophyll a and the rate of photosynthesis at different wavelengths of light.

Wavelength of light (nanometres)	Light absorbed by chlorophyll a (%)	Rate of photosynthesis (arbitrary units)
400	54	70
450	5	60
500	7	35
550	9	18
600	10	35
650	50	58
700	4	10

- a. On the graph paper provided (use the 2 mm grid scale), draw a graph to show the relationship between the wavelength of light, the light absorbed and the rate of photosynthesis. Join the points of the graph with straight lines. Plot the wavelength of light on the x-axis. Using the same scale plot the light absorbed by chlorophyll a and the rate of photosynthesis on the y-axis. (6)
- b. Use the graph to explain why the highest rate of photosynthesis occurs at a wavelength of 400 nanometres. (2)
- c. Besides the wavelength of light, name **TWO** other abiotic factors that affect the rate of photosynthesis. (2)
- d. State how the surface area of the leaf affects the rate of photosynthesis and give a reason for your answer. (2)

**(Total: 12 marks)**

**SECTION B: Answer any THREE questions from this section.**

3. A newspaper reported the case of an Australian teenage girl, whose menstrual bleeding could not stop. Finally doctors diagnosed the Von Willebrand's disease; a genetic bleeding disorder where a clotting protein in the blood is missing or defective.
- This girl reported frequent fainting and breathlessness. Explain why her doctor prescribed iron supplements to help her overcome these problems. (3)
  - Von Willebrand's disease is an autosomal recessive disease. It occurs equally in men and women, however, the phenotype is more pronounced in females.
    - Define the term *autosomal*. (2)
    - Explain why the phenotype is more pronounced in females. (1)
  - Neither the girl's mother nor father had the disease. Using **R** to represent normal and **r** to represent the disease, draw a genetic diagram to explain how this girl inherited the disease. (4)
  - Blood clotting is a very important process taking place in the human body.
    - Give **TWO** reasons why blood clotting is important. (2)
    - Name the blood components essential for blood clotting. (1)
  - Blood cells in human blood include red blood cells and lymphocytes, a type of white blood cells.
    - State the function of red blood cells and lymphocytes. (2)
    - List **TWO** structural differences between red blood cells and lymphocytes. (2)
  - The heart pumps blood around the body in blood vessels.
    - Explain why humans are said to have a double circulation. (3)
    - List **THREE** differences in structure between arteries and veins. (3)
  - During a medical test, an old man was diagnosed with a heart murmur resulting from a leaking bicuspid valve. Explain how this can affect the old man's life. (2)

**(Total: 25 marks)**

*Please turn the page*

4. The Citrus Tristeza virus attacks citrus trees. It may be introduced into the citrus trees either through grafting or by aphids that are infected by the virus. There are several species of aphids that can infect citrus trees with the virus including the aphid *Taxoptera citricida*.
- a.
    - i) Describe **TWO** ways how the scientific name of other species of aphid may vary from that of *Taxoptera citricida*. (2)
    - ii) Aphids can exist in two forms winged or wingless. Winged forms develop when aphid numbers are high in their habitat. Explain how this adaptation is a benefit to these organisms. (2)
    - iii) A farmer finds aphids on the leaves of orange trees. The farmer sprays a mixture of a vegetable oil and detergent on the leaves instead of using a broad-range insecticide. Explain the choice made by the farmer. (2)
  - b. Both aphids and the Citrus Tristeza virus are considered to be parasites on citrus trees. The Citrus Tristeza virus brings about stem pitting (open pores in stem), yellowing of leaves, smaller fruit yield, stunted growth and occasionally the death of the citrus trees. The virus reproduces in the phloem.
    - i) Define the term *parasite*. (1)
    - ii) Although the Citrus Tristeza virus infects both the aphids and the citrus trees, it is considered to be parasitic on the citrus tree only. Give **ONE** reason for this observation. (2)
    - iii) Define the term *tissue*. (1)
    - iv) Draw a well-labelled diagram of a virus. (4)
    - v) Describe, using diagrams if required, the replication cycle of a virus. (4)
    - vi) Indicate **ONE** reason why the infection of the virus causes a smaller fruit yield and stunted growth. (2)
  - c. Aphids, garden snails, earwig, grasshoppers and ants feed on leaves of citrus trees. Earwigs feed also on aphids and snails. Birds and mice feed on grasshoppers and spiders. Spiders feed on ants. Rats feed on orange fruit as well as insects such as grasshoppers. Draw a food web of the above feeding relationships. (5)

**(Total: 25 marks)**



5. a. The diagram below shows a setup used in determining the rate of diffusion at different temperatures. Students used cores of the vegetable beetroot in water at different temperatures. An increase in temperature also increases the rupturing of membranes.

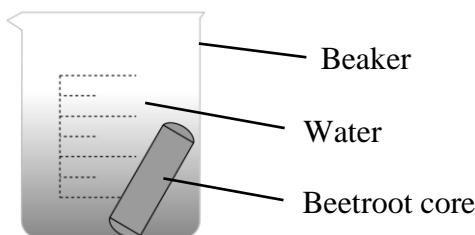


Figure 5: Beetroot core placed in a beaker of water

The students observed the diffusion of the beetroot pigment in water and compared the different intensities of colour obtained under the naked eye and using a colorimeter. A colorimeter reads the intensity of a colour.

Clear water gives a reading of 100 while full colour gives a reading of 0.

The following results were obtained.

Table 5: Experimental results showing colour of solutions and colorimeter readings at different temperatures

Temperature (°C)	0	20	40	60	80
Colour in solution	Clear	Very pale pink	Pale pink	Pink	Dark pink
Colorimeter reading (% transmission)	99.5	95.0	78.0	36.7	4.2

- i) Describe and explain the relationship between the rate of diffusion and temperature. (5)
  - ii) List **TWO** factors that need to be kept constant in this investigation. (2)
  - iii) The pigment is stored in the vacuole of plant cells. It is only when the cell membrane or vacuolar membrane ruptures that the pigment seeps out. Explain why. (1)
  - iv) Give **ONE** other function of permanent vacuoles. (1)
- b. The vegetable beetroot is a storage tap-root.
- i) Explain how this statement indicates that the vegetable beetroot is a dicot. (2)
  - ii) State how the leaves and the flowers of the beetroot plant will also indicate that the beetroot plant is a dicot. (2)
  - iii) Explain why the beetroot plant is expected to be larger than a moss plant. (2)
  - iv) Explain why the sexual reproduction in a beetroot plant can occur in drier environments than in ferns. (2)
  - v) State how the formation of seeds in the beetroot plant is different from the formation of seeds in a gymnosperm. (2)

*This question continues on next page.*

- c. In an investigation on transpiration, a student used one stalk and leaf of the beet plant to measure the rate of water loss. The student measured the total surface area of the leaf and determined the rate of water loss per unit area. The student then took readings as the conditions surrounding the leaf were changed.

State the change in the potometer readings in the following conditions and give **ONE** reason for your answer:

- i) lower surface of the leaf covered with Vaseline<sup>TM</sup> (petroleum jelly); (3)
- ii) leaf closed in bag. (3)

**(Total: 25 marks)**

6. a. Ten years ago, a man was diagnosed with a brain tumour in the cerebral hemisphere that controlled speech and movement. A tumour is an abnormal growth of cells which due to a mutation, start dividing uncontrollably.

- i) Name the type of cell division occurring in a tumour and state **TWO** characteristics of cells produced by this cell division (1, 2)
- ii) In multicellular organisms, cell division is a continuous process. State **TWO** reasons why cell division is important. (2)
- iii) During the surgery, the man was given local anaesthetic and was wide awake, talking throughout the operation. Local anaesthetic stopped pain sensations in the area of the body undergoing surgery. Explain how the anaesthetic affected the nervous system. (2)
- iv) List **TWO** ways how the brain is protected from injury. (2)
- v) A person who is unconscious is still able to breath and the pulse can still be felt. Explain. (2)
- vi) The brain is an organ. Define the term *organ*. (2)
- vii) The cerebrum is part of the brain. It includes sensory, motor and association areas within in. Distinguish the different role of each area within the cerebrum. (3)

- b. When touching a hot kettle, a person immediately withdraws his hand. Receptors in the skin detect the stimulus and send a nerve impulse to the spinal cord. A nerve impulse then passes back to the effectors which bring about an immediate response.

- i) Name this immediate response. (1)
- ii) Draw a well labelled diagram of a cross section of the spinal cord. Label the neurones involved in the response. Draw arrows to show the direction of the nerve impulse. (2, 3, 3)

**(Total: 25 marks)**

7. A group of students studied the effects of sewage run-off into a local stream. The students observed the changes in the levels of oxygen concentration, bacterial population and algae (algal) growth in the stream. Figure 7 below shows a graph showing the changes in these three factors.

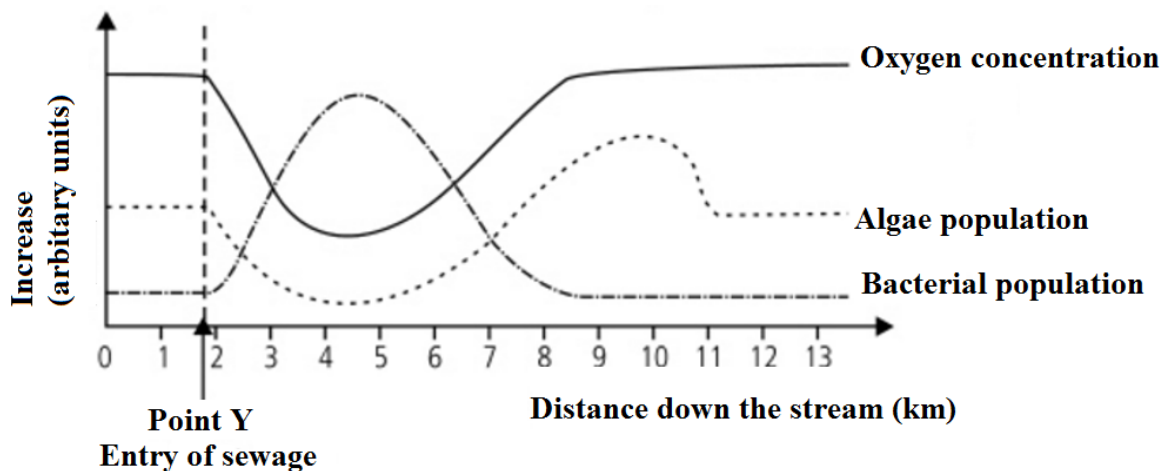


Figure 7: Variation of oxygen concentration, algae population and bacterial population with distance down the stream  
<http://www.hourlybook.com/wp-content/uploads/2015/02/403x286x162.png.pagespeed.ic.5-f4VPotvK.png>

- a. i) Use the graph to describe the changes in the bacterial population in relation with the oxygen concentration from the point of sewage entry up to 12 km downstream. (4)
- ii) Explain the reason behind the relationship. (2)
- b. Explain how the change in oxygen concentration from 3 km to 6 km downstream may affect:
  - i) aquatic animals; (2)
  - ii) aquatic plants living in that area. (3)
- c. Explain how the death of bacteria affects the increase in the algal population from 8 km to 10 km. (3)
- d. Ta' Barkat sewage treatment plant uses biological treatments to clean sewage waste water from dissolved waste particles. Denitrification is a useful process in sewage treatment but considered wasteful in the nitrogen cycle. Explain. (3)
- e. The sewage treatment plant also breaks down solid waste filtered from sewage using bacteria to produce methane gas (biogas). The gas is then used to generate electricity to work part of the plant.
  - i) The production of methane is a fermentation process. Explain. (2)
  - ii) Methane fermentation is described as a *Pollution Reduction Process*. Explain. (3)
- f. Methane is a greenhouse gas.
  - i) Name **ONE** other greenhouse gas. (1)
  - ii) Describe **TWO** effects of greenhouse gases on the environment. (2)

**(Total: 25 marks)**

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

## SECONDARY EDUCATION CERTIFICATE LEVEL

## MAY 2017 SESSION

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SUBJECT:	<b>Biology</b>
PAPER NUMBER:	IIB
DATE:	9 <sup>th</sup> May 2017
TIME:	4:00 p.m. to 6:05 p.m.

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**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.**

1. The disease Vibriosis affects marine fish growing in fish farms. It is called Vibriosis as it is caused by a genus of bacteria called *Vibrio*.

Vibriosis is very common in *Sparus aurata* (gilthead sea bream in English, awrata in Maltese). Although this species is the most commonly farmed marine finfish species in the Mediterranean, it is easily infected by *Vibrio harveyi* when compared to other farmed marine finfish.

- Name the kingdoms in which *Vibrio harveyi* and *Sparus aurata* are classified in. (2)
- Give **TWO** structural differences between a cell extracted from a fish, and a cell of the bacterium *Vibrio*. (2)
- Name the phylum and class that *Sparus aurata* is classified in. Give **TWO** characteristic structural features of all organisms belonging to this phylum. (4)
  - List **TWO** characteristic structural features that *Sparus aurata* shares with other fish. (2)
  - List **ONE** characteristic that may be used to distinguish *Sparus aurata* from other fish. (2)

Although Vibriosis is generally treated by antibiotics, *Vibrio harveyi* is becoming antibiotic resistant. Due to this fact, more research is going on to try to find other methods to prevent and control the bacterium. This research involves the product TEX-OE®; a substance that is extracted from the outer skin of the flowering plant, *Opuntia ficus-indica* (prickly pear in English, bajtar tax-xewk in Maltese).

- Name the kingdom and phylum in which *Opuntia ficus-indica* is classified in. (2)
- List **TWO** similarities and **TWO** differences between a cell extracted from *Sparus aurata* and a cell extracted from *Opuntia ficus-indica*. (4)
- Name **ONE** cellular structure that is present in **all** of the following: the bacterium *Vibrio harveyi*, in a cell extracted from *Sparus aurata* and a cell extracted from *Opuntia ficus-indica*. (2)

*Question continues on next page.*

TEX-OE® makes the production of heat shock proteins inside cells go faster. These proteins are normally produced when cells are under stressful conditions e.g. very high temperature. Heat shock proteins help cells to repair vital proteins and to continue producing new proteins. So if HSP's are present in the fish before it is infected by *Vibrio harveyi*, the fish will kill the bacterium faster and suffer less damage.

- g. Explain how a high temperature can have a negative effect on fish. (2)

In this study, the scientist tried to establish the pattern of growth of *Vibrio harveyi* at 20 °C, 30 °C and 37 °C. The method involves passing light through the flask where bacteria are grown. The greater the number of bacteria, the less light will pass through.

- h. At which of the three temperatures used in the experiment is the greater number of bacteria observed? Give **ONE** reason for your answer. (3)

(Adapted from Walker L., *Studies on the effects of Tex-OE® on microbial physiology and pathogenicity; in Biology Symposium Abstracts 2015, UOM*)

**(Total: 25 marks)**

2. A foreign newspaper reported the case of an Australian teenage girl, whose menstrual bleeding could not stop. Doctors diagnosed the Von Willebrand's disease; a genetic bleeding disorder where a clotting protein in the blood is missing or defective.

- a. This girl reported frequent fainting and breathlessness due to excess bleeding. Name a:
- deficiency disease she had developed;
  - mineral that was missing in her body. (2)
- b. Von Willebrand's disease is an autosomal recessive disease, occurring on chromosome number 12. It occurs equally in men and women, however, the phenotype is more pronounced in females.
- Define the term *autosomal*. (2)
  - Explain why the phenotype is more pronounced in females. (1)
- c. Both the girl's parents were heterozygous for Von Willebrand's disease. Using **R** to represent normal and **r** to represent the disease, draw a genetic diagram to show the probability of this couple having a child with Von Willebrand's disease. (5)
- d. Blood clotting is a very important process taking place in the human body.
- Give **TWO** reasons why blood clotting is important. (2)
  - Name the blood components essential for blood clotting. (1)
- e. Blood cells in human blood include red blood cells and lymphocytes, a type of white blood cells.
- State the function of red blood cells and lymphocytes. (2)
  - List **TWO** structural differences between red blood cells and lymphocytes. (2)
  - Phagocytes are other cells found in human blood. State the function of phagocytes. (2)
- f. The heart pumps blood around the body in blood vessels. In the form of a table, list **THREE** differences in structure between arteries and veins. (6)

**(Total: 25 marks)**

3. Green plants contain different pigments that absorb light at different wavelengths. The results below indicate the rate of photosynthesis at different wavelengths of light.

Table 3: The rate of photosynthesis at different wavelengths of light

Wavelength of light (nanometres)	Rate of photosynthesis (arbitrary units)
400	70
450	60
500	35
550	18
600	35
650	58
700	10

- a. On the graph paper provided (use the 2 mm grid scale), draw a graph to show the relationship between the wavelength of light (nm) and the rate of photosynthesis. Join the points of the graph with straight lines. (6)
- b. Name a plant pigment that absorbs light. (1)
- c. From the graph, list **TWO** wavelengths of light when the rate of photosynthesis is 40 (arbitrary units). (2)
- d. Besides the wavelength of light, name **TWO** other abiotic factors that affect the rate of photosynthesis. (2)
- e. Name **TWO** plant cells which carry out photosynthesis. (2)
- f. One of the products of photosynthesis is glucose.
- Name the other product produced in photosynthesis. (1)
  - Plants store glucose as starch. Describe how starch is built up from glucose. (1)
- g. When humans eat starch they digest it back to glucose.
- Describe the process how starch is digested to glucose in the human alimentary canal. In your answer, include the regions of the alimentary canal where starch is digested, the enzyme involved, the structure that releases the enzyme and the product formed. (You may present your answer in table format.) (6)
  - Explain why humans need to digest starch back to glucose. (2)
  - Explain why glucose is an important chemical in living organisms. (2)

**(Total: 25 marks)**

*Please turn the page.*

- 4.a. Ten years ago, a man was diagnosed with a brain tumour in a part of the cerebral hemisphere that controls speech and movement. A tumour is an abnormal growth of cells which due to a mutation, start dividing uncontrollably.
- i) Name the type of cell division occurring in a tumour and state **TWO** characteristics of cells produced by this cell division. (2, 2)
  - ii) In multicellular organisms, cell division is a continuous process. State **ONE** reason why cell division is important. (2)
  - iii) Name **ONE** way how the brain is protected from injury. (2)
  - iv) State **ONE** function of each of the following parts of the brain:
    - Cerebellum;
    - Pituitary gland. (2)
  - v) A person who is unconscious is still able to breath and the pulse can still be felt. Explain. (2)
  - vi) The brain is an organ. Name **TWO** organs located in the abdomen. (2)
- b.
- i) When touching a hot kettle, a person immediately withdraws his hand. Receptors in the skin detect the stimulus and send a nerve impulse to the spinal cord. A nerve impulse then passes back to the effectors which bring about an immediate response. Name this immediate response. (1)
  - ii) Draw a well labelled diagram of a cross section of the spinal cord. In your diagram, clearly show the following labels:  
*Effectors, Stimulus, Sensory neurone, Motor neurone, Relay neurone*  
 Draw arrows to show the direction of the nerve impulse. (2, 5, 3)

**(Total: 25 marks)**

5. a. The diagram below shows a section through a flower at two stages in its development.

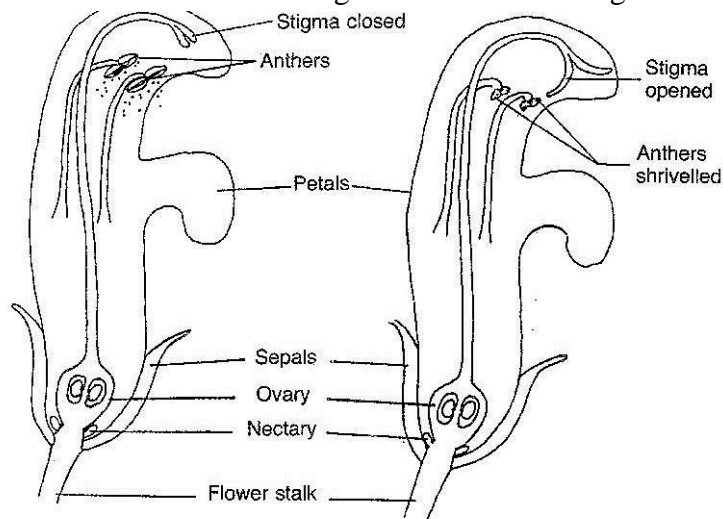


Figure 5.1: A cross section through an insect-pollinated flower at two different stages

- a.
  - i) List **TWO** features shown in the diagram which suggest that the flower is insect pollinated. (2)
  - ii) Cell division by meiosis takes place in the flower. Identify the **TWO** structures labelled in the diagram where meiosis takes place. (2)

- iii) What information shown in the diagrams would suggest that cross pollination takes place in this flower? (2)
- iv) A sequence of events occurs during sexual reproduction in a self-pollinated flowering plant. Write a short paragraph to describe what happens from the time of cell division by meiosis until the process of fertilization. (4)
- b. i) Tomato seeds will germinate after passing through the digestive system of an animal. Give **ONE** advantage that tomato plants gain when their seeds are eaten and passed through the digestive system of an animal. (2)
- ii) A student investigated germination in tomato seeds and wrote this conclusion:  
*“Stems show negative geotropism whilst roots show positive geotropism.”*  
 Explain this statement. (3)
- c. The diagram below shows a fruit.

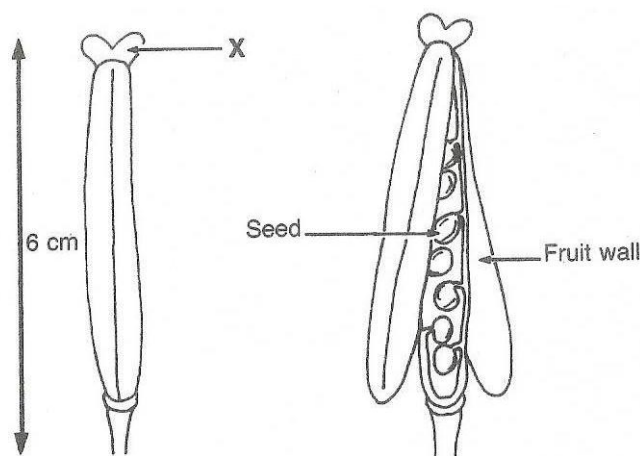


Figure 5.2: A closed and an open fruit

- i) From which parts of the flower have the fruit wall (pericarp), the seed and the part labelled **X** developed? (3)
- ii) Explain how the seeds of this fruit are dispersed. (2)
- d. The diagram below shows the human male reproductive organs.

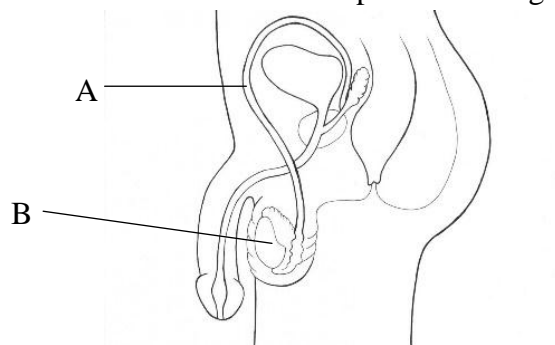


Figure 5.3: The human male reproductive system

- i) Name parts A and B. (2)
- ii) Name the organ through which semen is ejaculated out of the male body. (1)
- iii) During puberty, testosterone secretion leads to the growth of hair on the body. Describe **TWO** other secondary characteristics, other than hair growth, that also develop during puberty in a male. (2)

**(Total: 25 marks)**



6. The Citrus Tristeza virus attacks citrus trees. It may be introduced into the citrus trees either through grafting or by aphids that are infected by the virus. There are several species of aphids that can infect citrus trees with the virus including the aphids *Taxoptera citricida* (Brown citrus aphid), *Aphis spiraecola* (Spirae aphid) and *Taxoptera aurantii* (Black citrus aphid).
- Identify the **TWO** aphids that are closely related to each other. Give a reason for your answer. (3)
    - Give **ONE** advantage of using the scientific name of an organism instead of its common English name. (2)
    - Aphids can exist in two forms; winged or wingless. Winged forms develop when aphid numbers are high in their habitat. Explain how this adaptation is of a benefit to these organisms. (2)
    - A farmer finds aphids on the leaves of orange trees. The farmer sprays a specific mixture of vegetable oil and detergent on the leaves instead of using a broad-range insecticide. Explain the choice made by the farmer. (2)
  - Both aphids and the Citrus Tristeza virus are considered to be parasites on citrus trees. The Citrus Tristeza virus brings about stem pitting (open pores in stem), yellowing of leaves, smaller fruit yield, stunted growth and occasionally the death of the citrus trees. The virus reproduces in the phloem.
    - Define the term *parasite*. (2)
    - Define the term *tissue*. (2)
    - Draw a well-labelled diagram of a virus. (4)
    - Indicate **ONE** reason why the infection of the virus causes a smaller fruit yield and stunted growth. (3)
  - Aphids, earwig, grasshoppers and snails feed on leaves of citrus trees. Earwigs feed also on aphids and snails. Birds and mice feed on grasshoppers. Draw a food web of the above feeding relationships. (5)

**(Total: 25 marks)**

7. A group of students studied the effects of sewage run-off into a local stream. The students observed the changes in the levels of oxygen concentration, bacterial population and algae (algal) growth in the stream. Figure 7 below shows a graph showing the changes in these three factors.

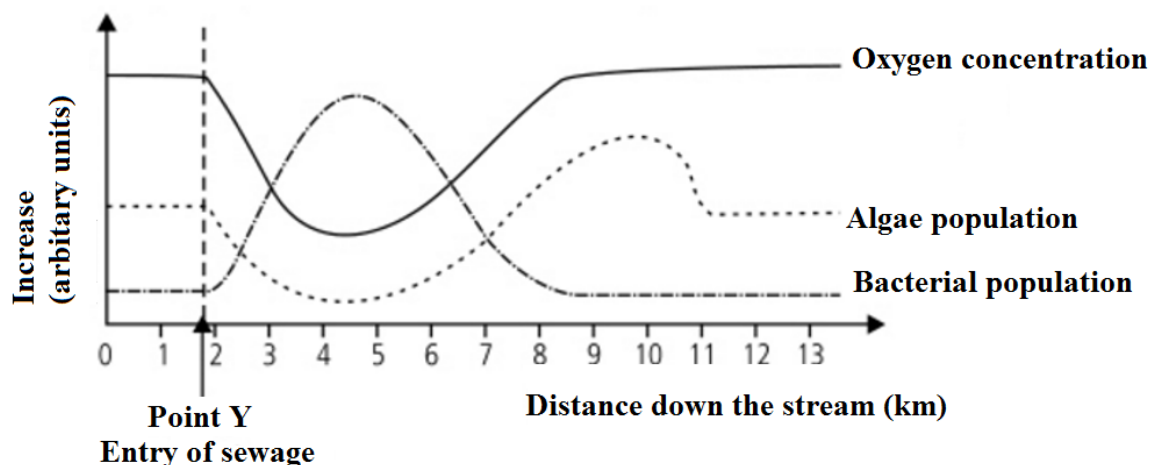
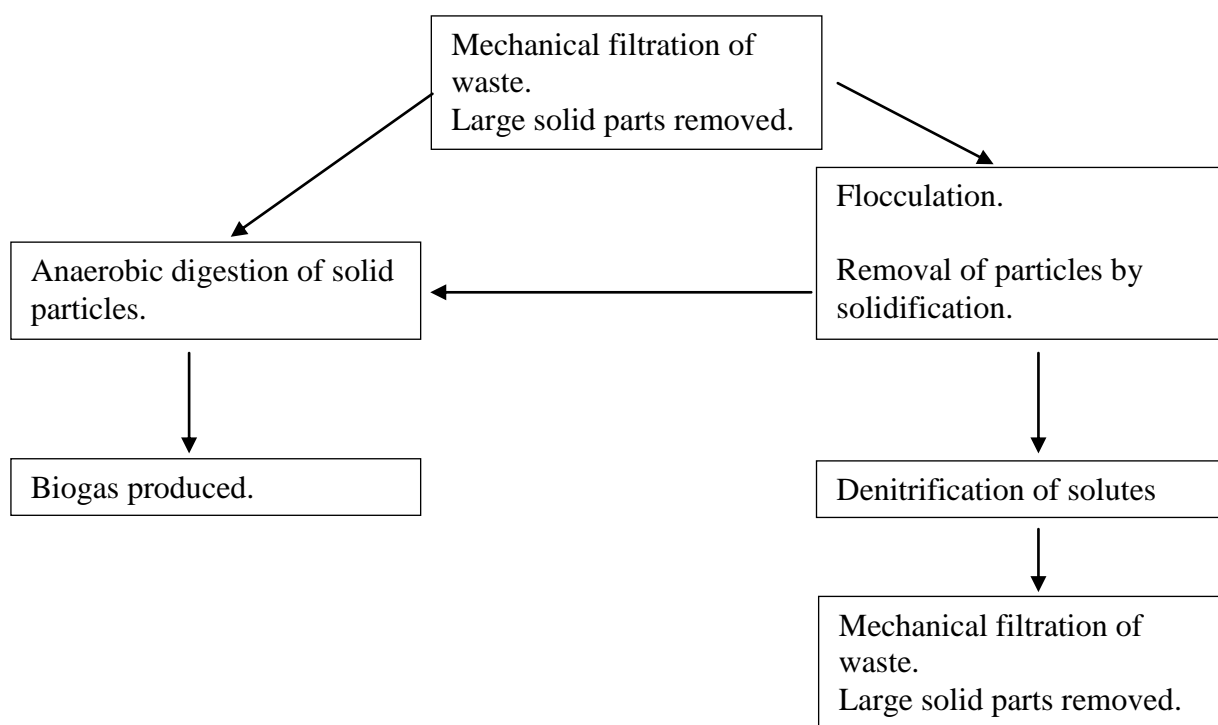


Figure 7: Variation of oxygen concentration, algae population and bacterial population with distance down the stream  
<http://www.hourlybook.com/wp-content/uploads/2015/02/403x286x162.png.pagespeed.ic.5-f4VPotvK.png>

- a. Use the graph to describe the changes in:
  - i) bacterial population; (3)
  - ii) oxygen concentration from the point of sewage entry up to 12 km downstream. (2)
- b. Explain how the change in oxygen concentration from 3 km to 6 km downstream may affect aquatic animals living in the area. (3)
- c. i) Describe the relationship between the algae population and the oxygen concentration between 2 km and 9 km of the stream. (2)
- ii) Explain what might cause the algae population to decrease at 11 km downstream. (3)
- d. Ta' Barkat sewage treatment plant uses biological treatments to clean sewage wastewater from dissolved waste particles. Below is a flow chart showing how the plant works.



- i) The sewage treatment plant uses both aerobic and anaerobic processes. Distinguish between an anaerobic process and an aerobic process. (2)
- ii) In one chamber denitrifying bacteria are used for denitrification. Describe the role of these bacteria and name the gas produced by these bacteria. (2, 1)
- iii) The sewage plant also breaks down solid waste filtered from sewage using bacteria to produce methane gas (biogas). The gas is then used to generate electricity to work part of the plant. Use the statement to show why the production of methane is a means to reduce air pollution. (3)
- e. Methane is a greenhouse gas.
  - i) Name **ONE** other greenhouse gas. (1)
  - ii) List **THREE** effects of greenhouse gases on the environment. (3)

**(Total: 25 marks)**

*Please turn the page.*

8. a. In an investigation on transpiration, a student used one stalk and leaf of the beet plant to measure the rate of water loss. The student determined the total surface area of the leaf and then calculated the rate of water loss per unit area. The student took readings as the conditions surrounding the leaf were changed. The following are the results taken by the students.

Table 8: Water loss from leaves of a beet plant placed in different environmental conditions

Treatment	Water loss from leaves in arbitrary units				
	1 <sup>st</sup> reading	2 <sup>nd</sup> reading	3 <sup>rd</sup> reading	4 <sup>th</sup> reading	5 <sup>th</sup> reading
Room	5	5	5	5	5
Warm air	5	5	5	7	8
Fan	5	6	7	8	9

- i) Describe the change in readings when the plant was first put in warm air and then near a fan. Give **ONE** reason for each change. (2, 4)
  - ii) Explain the change in reading you would expect if the shoot and leaf were enclosed in a bag. (3)
  - iii) Explain how gaseous exchange occurs in a leaf. (3)
- b. In a second investigation, the student set up the following apparatus to investigate the rate of diffusion of a pigment from the vegetable beetroot. The student used cores of the beetroot and put each core in a beaker.

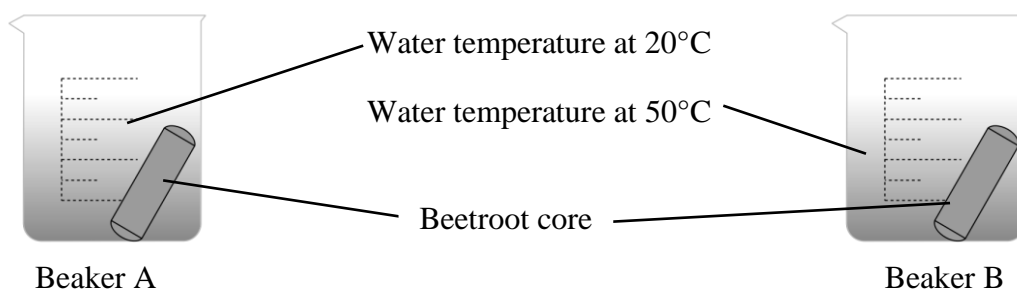


Figure 8: Beetroot placed in two beakers of water at different temperatures

The student observed the diffusion of the beetroot pigment in water and compared the different intensities of colour obtained under the naked eye.

- i) Define *diffusion*. (2)
  - ii) Give the letter of the beaker where you would expect the most pigment to diffuse out of the core. (1)
  - iii) The pink pigment is stored in the vacuole of plant cells. Give **ONE** other function of permanent vacuoles. (2)
  - iv) The main storage carbohydrate in vegetable beetroot is sucrose. Describe the molecule of sucrose. (2)
- c. The vegetable beetroot is a storage tap-root. This type of root system indicates that the plant is a dicot.
- i) State how the leaves and the flowers of the beetroot plant will also indicate that the beetroot plant is a dicot. (2)
  - ii) Explain why the beetroot plant is expected to be larger than a moss plant. (2)
  - iii) Explain why the sexual reproduction in a beetroot plant can occur in drier environments than in ferns. (2)

**(Total: 25 marks)**