Index Number:_____ SEC04/1.21m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2021 MAIN SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	I
DATE:	4th June 2021
TIME:	4:00 p.m. to 6:05 p.m.

Answer **ALL** questions in this paper in the spaces provided.

1. Multicellular organisms have specialised cells. Each type of specialised cell has a specific function. Fill in the table below with the appropriate statements.

Cell	Function	Specialisation	How the specialisation helps the cell carry out its function
Root hair cell		Large surface area	
Sperm cell	Fertilisation		
Red blood cell			Maximises the absorption of respiratory gas

(Total: 8 marks)

2. A field contains several communities and populations.

   a. Distinguish between a community and a population.

_____

_____

_____

_____(2)

   b. A group of scientists determined the biomass of organisms at different trophic levels of a field. The following results were obtained:

Trophic level	Biomass (g/m^2)
Producers	2000
Primary consumers	675
Secondary consumers	150
Tertiary consumers	75

   i) What is a producer?

_____

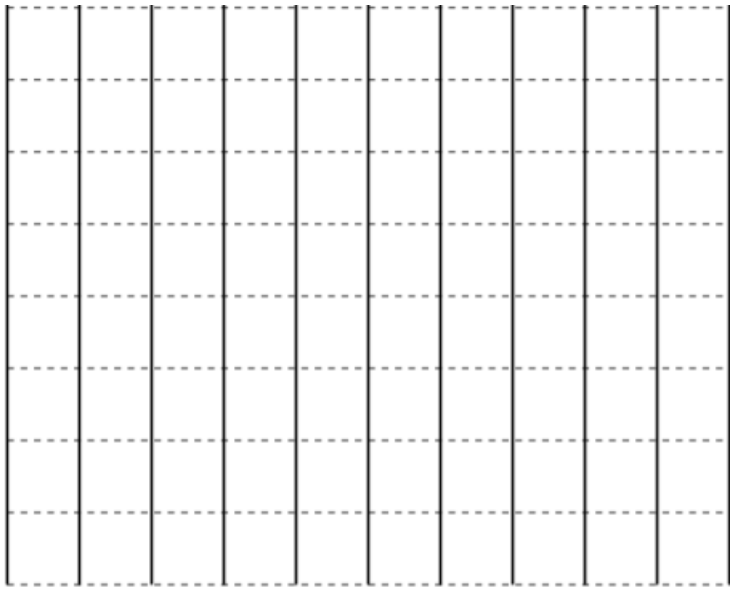
_____ (2)

   ii) Define biomass.

_____

_____ (1)

   iii) In the grid on the adjacent page, draw a pyramid of biomass of the field ecosystem above. Include **THREE** levels of producers, herbivores and carnivores. Use the empty space to show any working. The pyramid should be drawn to scale and labelled appropriately.



Space to show working

(5)

iv) Describe what happens to most of the energy at **each** trophic level. Give **ONE** reason for your answer.

_____

_____

_____ (1, 2)

(Total: 13 marks)

3. Beta-Thalassaemia is an inherited condition caused by a mutated allele on chromosome 11. This mutation gives rise to abnormal haemoglobin. Anaemia (reduced amount of red blood cells) is one of the signs of this condition. People with two mutated alleles are known as Thalassaemia majors. Heterozygotes have little or no symptoms of the disease and are considered as carriers. The mutated allele is recessive.

a. Is Beta-Thalassaemia an autosomal or sex-linked condition? Give **ONE** reason for your answer.

_____

_____

_____(1, 1)

This question continues on next page.

b. A female carrier of Thalassaemia marries a man who is a Thalassaemia major. Fill in the genetic diagram below to find the percentage chance of children being carriers of the disease. In your diagram use the symbol **T** for normal allele and **t** for Thalassaemia allele.

	Mother	Father
Genotype	_____	_____
Gametes	◯ ◯	◯ ◯

Genetic Diagram/Punnett square:

Percentage chance:_____ (4)

c. Explain why an Anaemic person constantly feels tired.

_____

_____(2)

d. Anaemia may be caused by the deficiency of a mineral ion. Name this mineral ion.

_____(1)

(Total: 9 marks)

4. The figure below shows a section of the thoracic cavity.

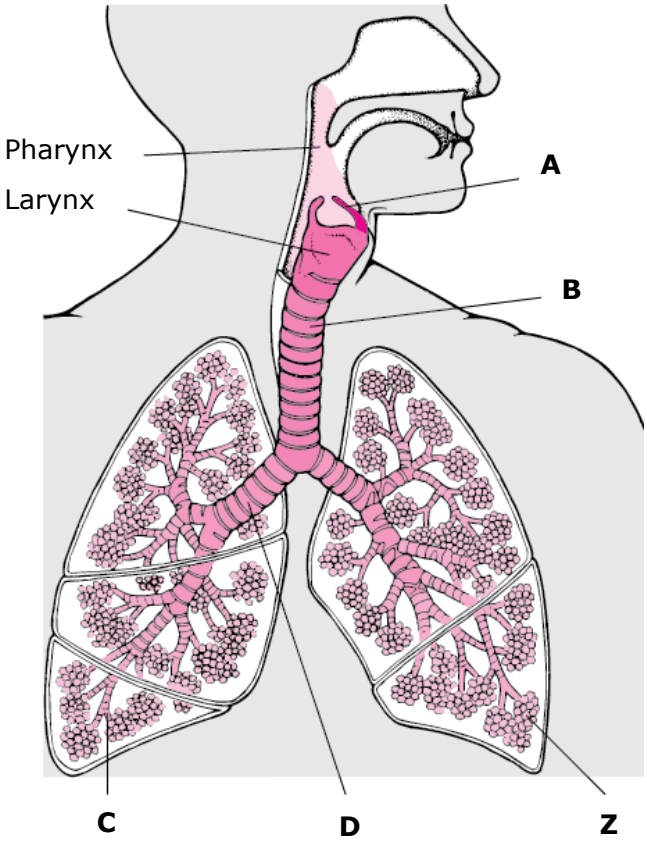


Figure 4.1: Diagram of structures of the thorax
(Source: www.msdmanuals.com/home/lung-and-airway-disorders/biuology/of/the/lungs/and/airways)

a. i) Label the structures A to D.

A _____ B _____

C _____ D_____(2)

ii) What happens to the air when it reaches structure **Z**? Describe how this happens.

_____

_____

_____

_____ (1,2)

b. Explain why it is very difficult to inhale if the wall of the chest has been punctured by a stab wound.

_____

_____(2)

This question continues on next page.

c. Asthma is a very common condition. It is caused when the walls of the bronchioles go into spasm and contract. Various triggers such as dust, pollen and animal hairs may bring on an attack. State **ONE** reason why a person's breathing rate increases during an asthma attack.

_____(1)

d. Explain how the diaphragm, ribs and intercostal muscles bring about the movement of air into the lungs.

_____

_____

_____(3)

(Total: 11 marks)

5. A recent study published in the *Journal of Agricultural and Food Chemistry* states that a baking soda (sodium hydrogen carbonate) soak is the most effective method of removing pesticide residue from fruit and vegetables.

When lettuce leaves were given a baking soda soak for 15 minutes, the leaves went limp (Figure 5.1), however, after soaking them in cold water for 15 minutes they turned firm again (Figure 5.2).

Figure 5.1

Figure 5.2
(Source: https://khymos.org/2008/04/09/)

a. Explain what happened to the lettuce cells when they were soaked in:
   i) baking soda solution;

_____

_____(2)

   ii) cold water.

_____

_____(2)

b. Draw simple diagrams of a cell taken from the lettuce leaf in Figure 5.1 and Figure 5.2.

Cell from lettuce leaf in Figure 5.1	Cell from lettuce leaf in Figure 5.2

(2)

c. Cylinders of tissue from a beetroot are placed on a tile and cut into discs about 3 mm thick. They are washed in cold water for 5 minutes. Half of them are transferred to a water bath **A** at 30^0C and the other half to a water bath **B** at 70^0C, for 1 minute.

The discs are then dropped into two separate test tubes filled with water for 20 minutes. After 20 minutes the tubes are shaken, held up to the light to compare the colours of the liquids in each. The result show that there is no escape of pigment in one test tube but a deep red coloration appears in the other.

In which solution do you expect to observe a deep red coloration? Give a reason for your answer.

_____

_____

_____

_____

_____(4)

(Total: 10 marks)

Please turn the page.

6. Biofouling refers to the accumulation of microorganisms, plants, algae, or small animals on wet surfaces such as the underside of ships or boats. These organisms will interfere with the smooth movement of the vessel.
Figure 6.1 shows a power point slide presented during a lecture about organisms responsible for fouling:

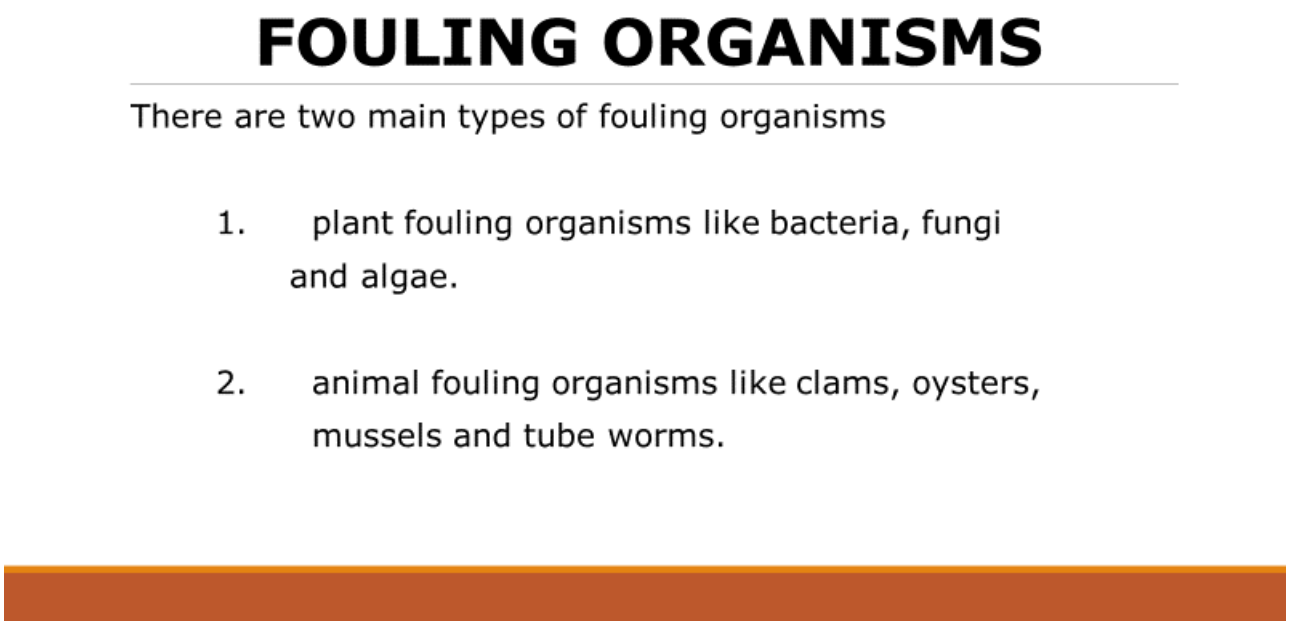


Figure 6.1: Power point slide about fouling organisms
(Adapted from: https://image.slidesharecdn.com/poojafoulingandboring)

a. i) Clams, oysters and mussels are all molluscs. List **TWO** structural features that distinguish molluscs from other animal groups.

_____

_____

_____(2)

ii) The slide states that bacteria and fungi are plant organisms. State if this statement is correct or incorrect and give a reason for your answer.

Correct/Incorrect: _____

Reason: _____

_____(2)

iii) Give **ONE** structural feature that is present in bacteria and the cells of fungi.

_____(1)

b. Biofouling is prevented by painting the underside of sea vessels with special paints containing substances called anti-fouling agents. Tributyltin (TBT) is a common anti-fouling agent. Studies have shown that concentrations of TBT in the sea have a negative effect on *Hexaplex trunculus*, a medium-sized sea snail.

In fact, TBT leads to the phenomenon of imposex in *Hexaplex trunculus*. This means that female snails develop male reproductive organs over the female genital opening.

i) Explain how imposex will affect the population of *Hexaplex trunculus*. Give **ONE** reason for your answer.

_____

_____

_____ (2)

ii) Identify **ONE** way how imposex may be avoided.

_____

_____ (1)

iii) Oil spills are another source of sea water pollution. List **TWO** negative effects that an oil spill may have on the marine ecosystem.

_____

_____

_____ (2)

(Total: 10 marks)

Please turn the page.

7. A group of students investigated the rate of transpiration in *Impatiens*, a popular indoor plant.

   The apparatus was set up as shown in Figure 7.1.

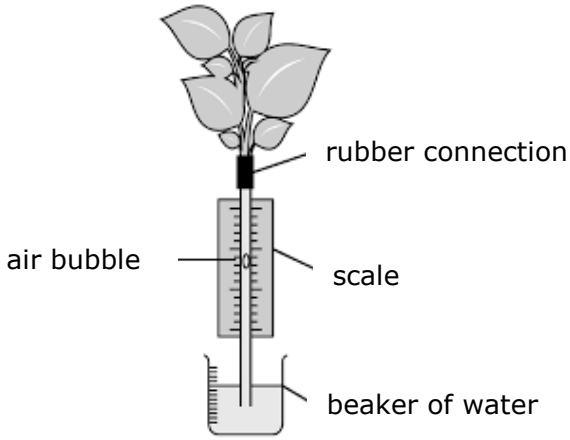
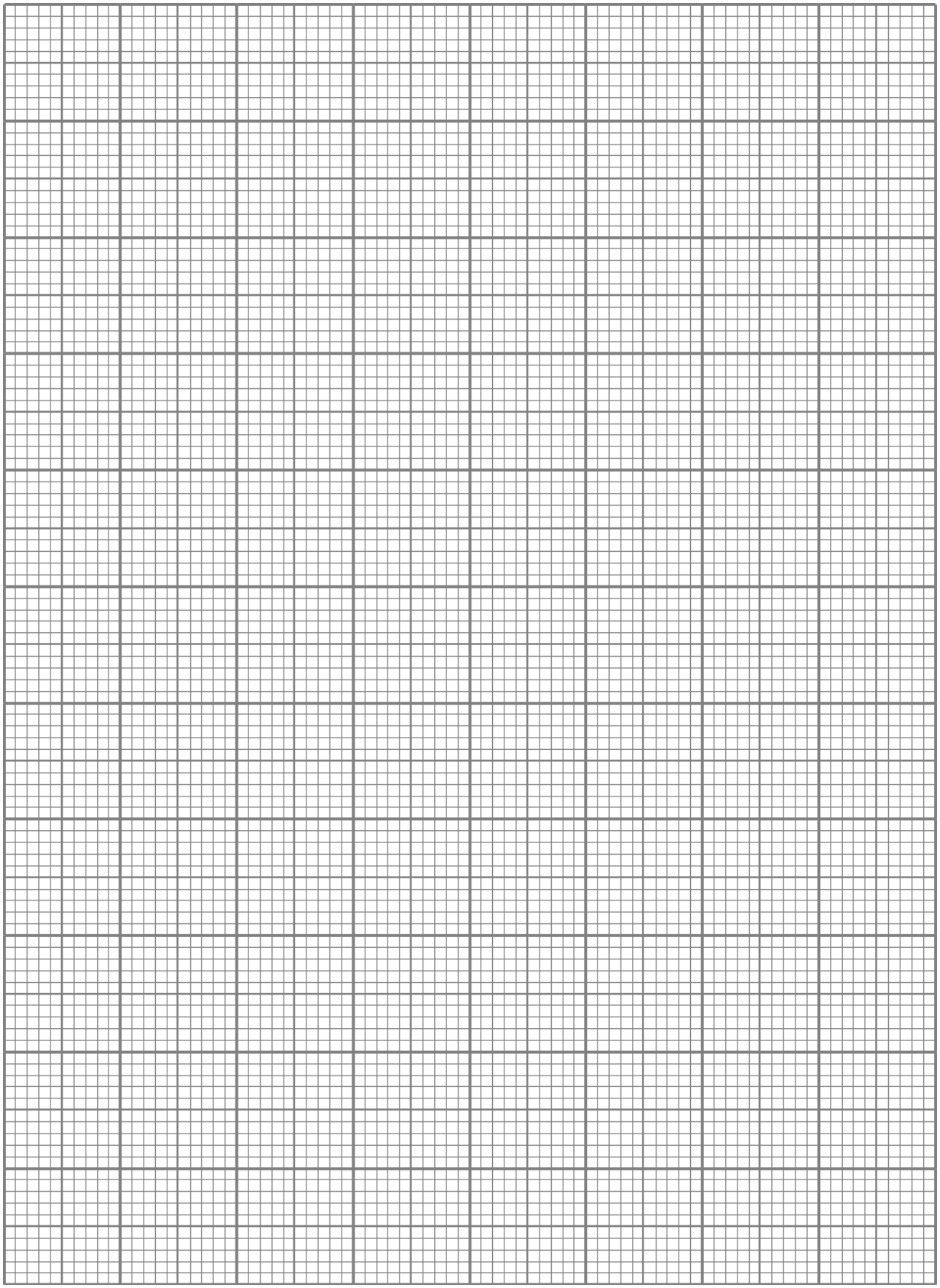


Figure 7.1: Apparatus set up to study transpiration
(Source: https://encrypted-tbn0.gstatic.com/images)

a. The table below shows the results obtained in the experiment.

Time / min	0	3	6	9	12	15
Distance moved by air bubble / mm	0	4	6	9	14	17

Use the graph paper provided, on the adjacent page, to draw a line graph showing the distance moved by the air bubble (on the y axis) against time (on the x axis). Draw the best straight line. (4)



This question continues on next page.

b. Use the graph to determine the rate of transpiration of *Impatiens* during the experiment. Show your working in the space provided.

Answer: _____ (2)

c. The experiment was repeated and the plant was sprayed with water at the start of the experiment and every 5 minutes. Describe and explain how this affected the rate of transpiration.

_____

_____

_____ (3)

(Total: 9 marks)

8. In biological control, predators, parasites and interspecific competitors may act as agents of biological control.

a. Define biological control.

_____

_____(2)

b. Differentiate between predators and parasites.

_____

_____(2)

c. Different species of tits (birds) such as the blue tit and the great tit often live together in European woodlands. The blue tit species and the great tit species are known to compete interspecifically for the same resource.
A common tree in European woodlands is the horse chestnut (*Aesculus hippocastanum).* A pest of this tree is the horse chestnut leaf miner (HCLM). The larva of this insect mines through leaves of the tree reducing photosynthesis and the production of seeds. Different species of tits feed on the larva and pupa of these insects.
In a research study to determine the effectiveness of tit species as a biological control on HCLM, nesting boxes were introduced in areas where there was an abundance of horse chestnut trees. This nesting boxes were large enough to allow breeding of both the blue tit and great tit species.

i) Name **ONE** leaf tissue that is eaten by the HCLM larvae.

_____(1)

ii) Describe **ONE** long term effect of the action of HCLM on the woodland.

_____

_____(2)

iii) From the text, name **ONE** common resource other than food of the blue tit and great tit species.

_____(1)

iv) Explain how will the interspecific competition of the food resource hinder the increase of the pest species.

_____

_____(2)

(Total: 10 marks)

9. A crop of maize seedlings was sprayed with a concentrated liquid fertiliser. Later, the seedlings began to wilt but recovered after rain fell. Within a few days a nearby small lake had developed a thick covering of algae. Later many fish died.

a. Give an explanation for **each** of the following:

i) Nitrate content of the small lake increased from 3.6 mg/dm^3 to 100 mg/dm^3.

_____(1)

ii) Growth of algae.

_____

_____(1)

iii) Death of the fish.

_____

_____

_____(3)

This question continues on the next page.

iv) pH of the lake decrease by 1.

_____(2)

b. List **TWO** reasons why the use of synthetic fertilisers is **not** allowed in organic farming.

_____

_____(2)

c. State **ONE** alternative method organic farmers use to enhance soil fertility.

_____(1)

(Total: 10 marks)

10. a. The table below lists a number of organisms commonly referred to as worms and their characteristic features. Use the information given to identify the phylum that **each** worm belongs to:

Common name of the worm	**Scientific Name**	**Characteristic feature/s**	**Phylum**
Chestnut worm	*Lumbricus castaneus*	Long, segmented body. Digestive tract with a mouth and anus.	
Human Broad Tape worm	*Dibothriocephalus latus*	Thin and flat body. Parasitic.	
Human Whip worm	*Trichuris trichiura*	Long thread-like unsegmented body. Round in cross-section. Parasitic.	
Silk worm	*Bombyx mori*	A segmented body covered by an exoskeleton. The larva of the silk moth.	

(4)

b. The following organisms all belong to the same phylum as the Chestnut worm: the giant earthworm (*Lumbricus badensis*), the common earthworm (*Lumbricus terrestris*), the lugworm (*Arenicola marina*) and *Sabella spallanzanii* (European fan worm).

i) Identify the **TWO** worms that are closely related to the Chestnut worm. (Write the common names.) Give a reason for your choice.

Worms: _____

Reason: _____

_____(2)

ii) A student kept giant earthworms and common earthworms in the same terrarium for a year. The student observed that the offspring produced were either giant earthworms or common earthworms. Explain this observation.

_____

_____

_____(2)

c. The human broad tape worm and the human whip worm are both parasitic worms that live in and obtain nutrients from the human intestine. Relate their characteristic features to their parasitic mode of nutrition.

_____

_____

_____(2)

(Total: 10 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2021 MAIN SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IIA
DATE:	8th June 2021
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 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.

Unwelcome Chilean rodent joins the island's rat pack

A new mammalian species has been spotted roaming in the wild in Malta. The Chilean rodent, better known as the common degu, was spotted in woodland in Buskett.

But its presence is more than just an unusual sight: it's a problem for local flora and fauna because it reproduces at a rapid rate.

These rodents were most likely imported as pets and then released but are now living in the wild.

Local biologists reported that they had first come across the degu in Malta as early as 2018 and since then had observed and trapped specimens all across the island – in Albert Town, the Marsa golf course, Wied Blandun, Corradino, Buskett, Girgenti, Wied l-Isqof and Wied il-Għasel.

The common degu (*Octodon degus*) is roughly the size of a fancy rat – the type of rat bred for pets. It is found in the matorral ecoregion in Chile. This ecoregion is characterised by wet winters and prolonged hot summers. They are strictly herbivorous and are active during the day, however, in the height of summer they do not leave their burrows in the middle of the day as they suffer in high heat.

Although local biologists did not expect the species to survive the summer heat in Malta, they observed that the Chilean rodent was living successfully in humid areas such as local valleys, and breed successfully in Wied Blandun.

They said that the presence of the degu in the local ecosystems could be problematic for local biodiversity, especially as it reproduces at a very rapid rate.

The Environment Authority (ERA) said it is assessing the situation and it started a rapid response process to assess the best way to control the spread of Chilean rodent. ERA also noted that it is considering the presence of the rodent in humid valleys and areas with natural water springs in the Maltese Islands. The Authority also noted that in the past, some species were claimed as 'difficult to establish themselves in Malta.' However, these have now become invasive alien species in a number of areas in Malta and Gozo, including the Levantine Frog (il-qorru; iż-żriniġ l-għarib), the Red-Eared Slider (il-fekruna tal-ilma ħelu) and different Freshwater

Crayfish (iċ-ċkala tal-ilma ħelu). "These species are either pets that escaped from their owners or were deliberately released or discarded into the environment," the authority added.

It insisted that pets should never be deliberately released or abandoned into the environment, since many do not survive whilst others may not only thrive but become invasive. The latter leads to considerable environmental and economic issues, with potential impacts to nature and biodiversity as well as agriculture and fisheries, amongst other sectors.

(Adapted from: Arena J., Unwelcome Chilean Rodent; in The Times of Malta 21/11/2020)

a. Using information in the text, explain why referring to an organism with its scientific name is better than when using its common names. (2)

b. The Common Degu, the Levantine Frog (il-qorru, iż-żringˇ l-għarib) and the Red-Eared Slider (il-fekruna tal-ilma ħelu) all belong to the same phylum.
   i) Name the phylum to which these three organisms belong. (1)
   ii) Give **ONE** characteristic feature that allows these organisms to be classified in this phylum. (1)

c. List **TWO** features that allow plants to survive the prolonged hot summers in the matorral region in Chile. (2)

d. Give **ONE** reason why the common degu suffers at very high temperatures. (1)

e. From the text, give **TWO** pieces of evidence that the common degu is establishing itself successfully in the Maltese islands. (2)

f. Explain why the common degu is likely to survive in the local ecosystem. (2)

g. Give **TWO** reasons why "the presence of the degu in the local ecosystems could be problematic for local biodiversity, especially as it reproduces at a very rapid rate." (2)

(Total: 13 marks)

2. Soil is a fundamental natural resource. It provides many essential services on which we rely including food production, water management and support for valuable biodiversity and ecosystems. *(Source: www.fao.org)*

Soil infiltration is the soil's ability to allow water movement into and through the soil. Infiltration rate measures how fast water enters the soil i.e. depth of soil per hour. A soil with good infiltration combined with a high organic matter content, can utilise and store plant available water and reduce water runoff which causes flooding.
A study was carried out to determine 'Rainwater infiltration under different types of soil management' being soil management A and soil management B.
The following table shows the results of the study.

Rainfall infiltration (mm)		
time (hours)	Soil management A	Soil management B
1	110	48
2	80	35
3	76	35
4	65	28
5	60	26
6	58	24
7	55	20

a. On the graph paper provided (use the 2mm grid scale), plot a graph to show the rainfall infiltration for soil management A. Join the points of the graph with straight lines. Plot time on the x-axis. Using the same pair of axes, plot a graph for rainwater infiltration for soil management B. Join the points with straight lines. (6)

b. Describe **ONE** trend observed in the results of the study. (2)

c. Apart from rainfall, name **ONE** other factor that affects soil moisture in cultivated soil. (1)

d. Give **ONE** effect for **each** of the following properties of organic matter: (3)
   i) the typical dark colour of many soils;
   ii) organic matter groups soil particles together into structural units called aggregates;
   iii) organic matter is insoluble because it is associated with clay.

(Total: 12 marks)

Section B: Answer any THREE questions from this section. Each question carries 25 marks.

3. The diagram shows the human digestive system.

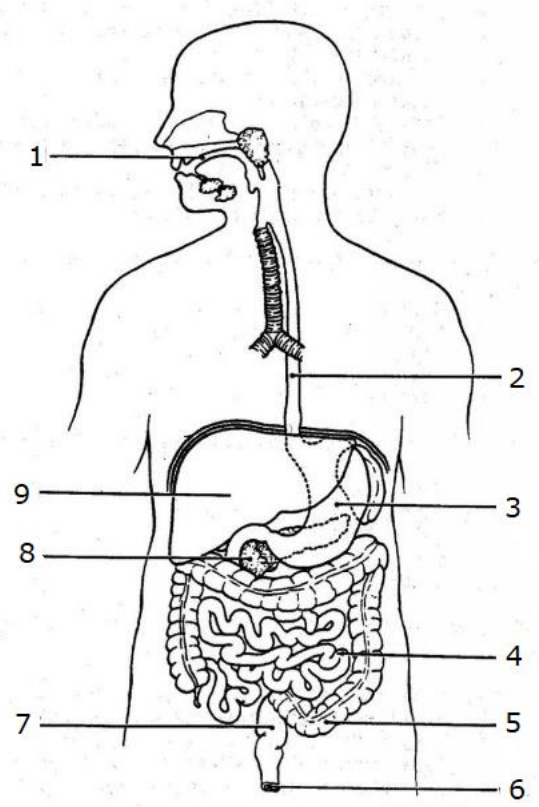

Figure 3.1: The human digestive system

(Source: Pinterest.com/pin/626844841882218378 7/)

a. i) Use the diagram above to give the name and corresponding number of the parts of the digestive system, in the order through which food passes. (7)

ii) Accessory organs assist in digestion, but food does **not** pass through them. Give the name of **TWO** accessory organs shown in the diagram. (2)

b. Carbohydrates and proteins are two different classes of food which are essential in the human diet. Copy the table and fill it in. (6)

	Elements that make up	The final product/s of digestion	Role in the efficient functioning of the human body
Carbohydrates			
Protein			

c. Doctors recommend a diet which includes cereals and bread with a high fibre content, vegetables and fruit, but which contains only small amounts of fried food and sugar. Give a different reason in **each** case why doctors recommend:

i) a diet that includes cereals and bread with a high fibre content; (1)

ii) a diet that includes vegetables and fruit; (1)

ii) a diet that includes only a little fried food. (1)

d. Explain why dietary fibre is **not** digested by the human body. (1)

e. How does a breast-feeding woman need to change her diet with respect to protein, calcium and iron intake? Explain your answer. (3)

f. The following diagram shows a cross section of the small intestine of a person who suffers from coeliac disease.

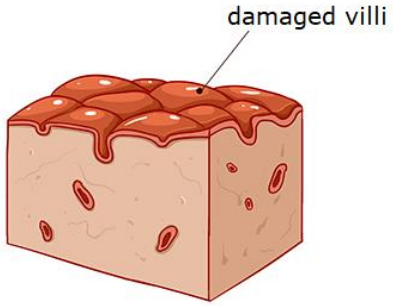

Figure 3.2: Damaged intestines caused by coeliac disease
(Source: https://www.beyondceliac.org/celiac-disease/)

The irritation caused by coeliac disease often destroys the villi in the small intestine. Explain why people with coeliac disease have stunted growth. (3)

(Total: 25 marks)

4. Fermentation is a process used to produce and improve on various types of foods.

a. Define fermentation. (2)

b. Green coffee makers use the process of fermentation to improve on the texture and consistency of this beverage. Yeast and lactic acid bacteria are used as fermentation agents. These micro-organisms digest and ferment the fruit mucilage (fruit pulp of the coffee tree). The fruit mucilage consists of polysaccharides mainly starch and cellulose.
   i) State **ONE** structural difference between yeast and bacterial cells. (2)
   ii) Explain why the micro-organisms digest the fruit components before fermentation. (3)
   iii) List the products of fermentation by yeast. (2)
   iv) In an article on green coffee, a student read that the pH of the fermenting solution decreases during the process. The author of the article proposes that for maximum fermentation, pH is kept constant. Explain. (3)

c. Kopi Luwak is a special type of coffee. Civets (mammals) eat the coffee cherries (fruits) which they egest partially digested onto the jungle floor. This material (faecal matter) is then collected and roasted to produce coffee. Civets have carnassial teeth (tear meat) and flat crown molars.
   i) List **TWO** characteristics of mammals. (2)
   ii) Give the function of molars. (2)
   iii) Are civets herbivores, omnivores or carnivores? Explain. (3)
   iv) In certain plantations, civets are taken from their habitat and put in cages. How will this affect the ecosystem? (2)

d. Yoghurt is another product of fermentation. If kept airtight or at cold temperatures it will **not** turn sour. Explain why yoghurt does **not** become sour unless the jar is open and left at room temperature. (4)

(Total: 25 marks)

5. The following diagram shows a vertical section of a flower.

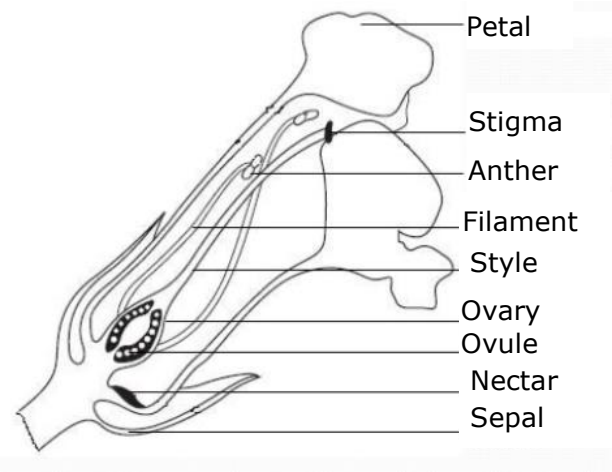

Figure 5.1: Vertical section of a flower

(Source: Slideshare.net)

a. i) Name **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. Name the **TWO** structures, labelled in the diagram, in which cell division by meiosis takes place. (2)

iii) Explain **THREE** changes that take place in the flower after pollination and fertilisation. (3)

b. i) Draw a labelled diagram of a vertical section through a broad bean seed and state the function of **each** label. (6)

ii) In a garden, maize seeds are undergoing hypogeal germination while beans are undergoing epigeal germination. What observation can be made to differentiate between these types of germination? (2)

iii) Describe the process of germination in the broad bean seed from the time it is sown till the first leaves start to photosynthesise. (6)

c. An experiment was carried out to investigate the best temperature needed for germination. The results showed that the seedlings kept inside the incubator at 31°C grew more than those at room temperature (21°C). The seeds in the refrigerator did not germinate. A student argued that the low temperature in the refrigerator had killed the seeds and that explained why they did not germinate.

i) How could one check on this possibility? (1)

ii) State **ONE** reason why the seeds in the incubator germinate faster than those at room temperature. (1)

d. Seeds and fruits are dispersed away from the parent plant.

i) Name the special feature of the seed or fruit that allows wind dispersal. (1)

ii) Explain how this feature helps in wind dispersal. (1)

(Total: 25 marks)

6. a. A new species of toadstool (kingdom: fungi), *Cortinarius heatherae*, was discovered along a river in London, UK. Mushrooms of this genus are ecologically important as they form symbiotic relationships with angiosperm trees and support the growth of these trees.
   i) Name the symbiotic relationship where both the fungi and the trees benefit from the association. (1)
   ii) In the symbiotic relationship, the hyphae of the mushroom link with the root of trees. Describe hyphae. (3)
   iii) List **TWO** characteristics of angiosperms. (2)
   iv) Give **ONE** reason why the fungus grows along a river. (2)

   b. Another angiosperm, *Tiganophyton karasense*, was discovered in the hot African country of Western Namibia. The characteristics of this plant were so unique that it was also given the family name of Tiganophytaceae in the order of Brassicales. The flower has four small petals. The leaves are reduced.
   i) Is the plant a monocot or dicot? Give **ONE** reason for your answer. (1, 2)
   ii) State **ONE** reason why the plant has evolved to have small leaves. (2)
   iii) List the scientific classification of this plant in the following order:
   Kingdom, Phylum, Class, Order, Family, Genus and Species (3)
   iv) DNA tests determined the classification of this organism. List **THREE** structural descriptions of a DNA molecule. (3)

   c. A journalist titled an article on earthworms as following:
   'Earthworms are not soil heroes'.
   Give **TWO** reasons why you disagree with this statement. (2)

   d. In an article on marine organisms, it was mentioned that certain fish hide from predators in sea anemones (cnidarians). Distinguish between fish and cnidarians. (4)

(Total: 25 marks)

7. a. Give a biological explanation for **each** of the following statements:
   i) The local environmental protection act puts certain areas such as a garrigue ecosystem under its protection. (3)
   ii) At dawn or dusk, the rate of photosynthesis is less than that measured at noon. (4)
   iii) Mosses do **not** survive in dry and hot conditions. (4)
   iv) Insects, arachnids, crustaceans and myriapods are all arthropods. (4)

   b. The statements below show common misconceptions. Explain why **each** statement is incorrect:
   i) Feeding relationships between organisms occur in a linear process. (3)
   ii) Plants take in all the substances they need to grow through their roots. (4)
   iii) Plants carry out cellular respiration only in cells that do **not** photosynthesise. (3)

(Total: 25 marks)

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2021 MAIN SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IIB
DATE:	8th June 2021
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 for question 6 of this paper you need the graph paper in the booklet.

Answer FOUR questions from this paper. Each question carries 25 marks.

1. The diagram shows the human digestive system.

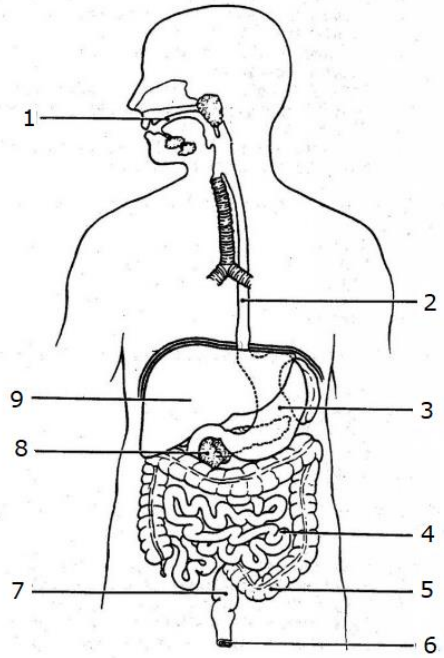

Figure 1.1: The Human Digestive System
(Source: Pinterest.com/pin/626844841882218378 7/)

a. i) Use the diagram above to give the name and corresponding number of the parts of the digestive system, in the order through which food passes. (7)
ii) Accessory organs assist in digestion, but food does **not** pass through them. Give the name of **ONE** accessory organ shown in the diagram. (1)

b. Carbohydrates and proteins are two different classes of food which are essential in the human diet. Copy the table and fill it in. (6)

	Elements that make up	The final product/s of digestion	Role in the efficient functioning of the human body
Carbohydrates			
Protein			

c. Doctors recommend a diet which includes cereals and bread with a high fibre content, vegetables and fruit but which contains only small amounts of fried food and sugar. Give a different reason in **each** case why doctors recommend:
   i) a diet that includes cereals and bread with a high fibre content; (1)
   ii) a diet that includes vegetables and fruit; (1)
   iii) a diet that includes only a little fried food. (1)

d. Explain why dietary fibre is **not** digested by the human body. (1)

e. How does a breast-feeding woman need to change her diet with respect to protein and calcium intake? (2)

f. i) The small intestine is adapted to absorb digested food by increasing its absorbing surface. How is the absorbing surface increased? (2)
   ii) The following diagram shows a cross section of the small intestine of a person who suffers from coeliac disease.

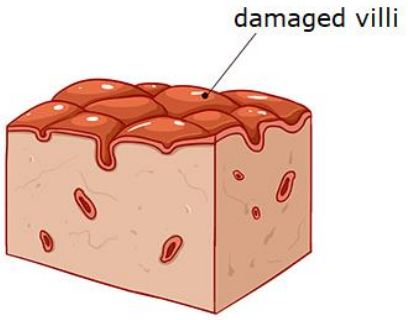

Figure 1.2: Damaged intestines caused by coeliac disease
(Source: https://www.beyondceliac.org/celiac-disease/)

The irritation caused by coeliac disease often destroys the villi in the small intestine. Explain why people with coeliac disease have stunted growth. (3)

(Total: 25 marks)

2. a. Green coffee makers use the process of fermentation to improve on the texture and consistency of this beverage. Yeast and lactic acid bacteria are used as fermentation agents. These micro-organisms digest and ferment the fruit mucilage (fruit pulp of the coffee tree). The fruit mucilage consists of polysaccharides mainly starch and cellulose.
   i) Why are yeast and bacteria defined as micro-organisms? (1)
   ii) State **ONE** difference between yeast and bacteria. (2)
   iii) Describe the structure of polysaccharides. (2)
   iv) Write down a word equation to show fermentation by yeast. (3)
   v) Explain why the micro-organisms digest the fruit components before fermentation. (3)

b. Kopi Luwak is a special type of coffee. Civets (mammals) eat the coffee cherries (fruits) which they egest partially digested onto the jungle floor. This material is then collected and roasted to produce coffee. Civets have flat crown molars.
   i) Define egestion. (2)
   ii) Give the function of molars. (2)
   iii) The stomach acids of the civets and the digestion process give this coffee a particular flavour. Describe the **TWO** roles of stomach acids in human digestion. (4)

iv) In certain plantations, civets are taken from their habitat and put in cages. How will this affect the ecosystem? (2)

c. Yoghurt is another product of fermentation. If kept airtight or at cold temperatures it will **not** turn sour. Explain why yoghurt does **not** become sour unless the jar is open and left at room temperature. (4)

(Total: 25 marks)

3. A new mammalian species has been spotted roaming in the wild in Malta. The Chilean rodent, better known as the common degu, was spotted in woodland in Buskett. But its presence is more than just an unusual sight: it's a problem for local flora and fauna because it reproduces at a rapid rate.

The common degu (*Octodon degus*) is roughly the size of a fancy rat – the type of rat bred for pets. It is found in Chile, in a region characterised by wet winters and prolonged hot summers. They are strictly herbivorous and are active during the day, however, in the height of summer they do not leave their burrows in the middle of the day as they suffer in high heat.

a. i) From the text give the scientific name of the Chilean rodent. (1)
ii) Using information in the text, explain why referring to an organism with its scientific name is better than when using its common names. (2)

b. List **TWO** structural characteristics that show that the Chilean rodent is a mammal. (2)

c. The common degu is 'strictly herbivorous'. Explain. (2)

d. i) Explain how staying in the burrows in the middle of the day helps the common degu to avoid high environmental temperatures. (2)
ii) The common degu does not have hair on its tail. It controls its body temperature by the process of vasodilation in the long tails. Explain. (3)

e. List **ONE** feature that allows plants to survive the prolonged hot summers in this region in Chile. (2)

f. Local biologists reported that they had first come across the common degu in Malta as early as 2018 and since then had observed and trapped specimens all across the island – in Albert Town, the Marsa golf course, Wied Blandun, Corradino, Buskett, Girgenti, Wied l-Isqof and Wied il-Għasel.

From the text, give **TWO** pieces of evidence that the common degu is establishing itself successfully in the Maltese islands. (2)

g. Although local biologists did not expect the species to survive the summer heat in Malta, they observed that the Chilean rodent was living successfully in humid areas such as local valleys, and breed successfully in Wied Blandun.
Explain why the common degu is likely to survive in the local ecosystem. (2)

h. Biologists said that the presence of the degu in the local ecosystems could be problematic for local biodiversity, especially as it reproduces at a very rapid rate.
Give **ONE** reason why the presence of the degu can be problematic for:
i) local plant species (1)
ii) local herbivorous species (1)

i. Explain why the presence of the common degu may lead to an increase in the number of carnivores on the Island. (2)

j. The Environment Authority (ERA) said it started a rapid response process to assess the best way to control the spread of Chilean rodent. Several imported species have now become invasive alien species in a number of areas in Malta and Gozo, including the Levantine Frog (il-qorru; iż-żringħ l-għarib), the Red-Eared Slider (il-fekruna tal-ilma ħelu) and different Freshwater Crayfish (iċ-ċkala tal-ilma ħelu). These species are "either pets that escaped or were deliberately released or discarded into the environment," the authority added. It insisted that pets should never be deliberately released or abandoned into the environment.

(Adapted from: Arena J., Unwelcome Chilean Rodent; in The Times of Malta 21/11/2020)

The Chilean Rodent, the Levantine Frog (il-qorru; iż-żringħ l-għarib) and the Red-Eared Slider (il-fekruna tal-ilma ħelu) all belong to the same phylum.

i) Name the phylum to which these three organisms belong. (1)
ii) Give **ONE** characteristic feature that allows these organisms to be classified in this phylum. (1)
iii) The Freshwater Crayfish is an arthropod. It has five pairs of jointed limbs. Name the class of this organism. (1)

(Total: 25 marks)

4. a. In 2020 several new species of living organisms were discovered. These included 6 new species of mushrooms including the Heathrow Airport toadstool (*Cortinarius heatherae*) and 19 new species of Orchids, all of which were found growing in New Guinea. Orchids are monocot plants.

i) Explain why chloroplasts were present in leaf cells taken from the orchids but none were present in cells taken from the Heathrow Airport toadstool. (2)
ii) The Heathrow Airport toadstool forms hyphae whilst the orchids form roots. Give **ONE** common function of hyphae and roots. (1)
iii) State **ONE** difference between the function of hyphae and roots. (2)
iv) All Orchids are monocots. Describe the general leaf structure of orchids. (2)
v) Draw a table to show differences in the root system, the floral parts and the seeds of monocots and dicots. (3)

b. There are two species of *Araucaria* in New Guinea: *Araucaria cunnignhamii* (common name: hoop pine) and *Araucaria hunsteinii* (common name: klinki pine). The two species are gymnosperms. The trees live in wet tropical environments, an unusual habitat for trees with needle-shaped leaves. There is intense competition between the two species.

i) Name the type of structures where the seeds of *Araucaria* develop. (1)
ii) Explain why the seeds of *Araucaria* are described as 'naked seeds'. (2)
iii) Explain why a wet tropical environment is unusual for trees with needle-shaped leaves. (4)
iv) Define the terms habitat and competition. (4)
v) Describe **TWO** ways how the hoop pine and the klinki pine compete together. (4)

(Total: 25 marks)

5. a. The following diagram shows a vertical section of an insect pollinated flower.

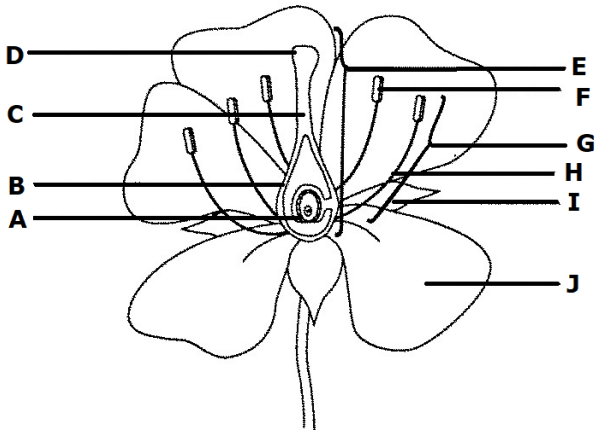

Figure 5.1: Cross-section of an insect pollinated flower
(Source: https://quizlet.com/381089706/flower-labeling-diagram/)

i) Name the parts A to J shown in Figure 5.1. (5)
ii) What are the functions of F and J? (2)
iii) Explain **TWO** changes that take place in the flower after pollination and fertilisation take place. (2)

b. i) Draw a labelled diagram of a vertical section through a broad bean seed. (4)
ii) In a garden, maize seeds are undergoing hypogeal germination while beans are undergoing epigeal germination. What observation can be made to differentiate between their type of germination? (2)
iii) The early stages of germination take place in the soil where there is little or no light for photosynthesis. How does the seedling obtain materials for its growth and energy during this time? (2)
iv) Describe the process of germination in the broad bean seed from the time the testa breaks open until the first leaves start to photosynthesise. (4)

c. An experiment is carried out to investigate the best temperature needed for germination. The results show that the seedlings kept inside the incubator at 31 ^{o}C grow more than those at room temperature (21^{o}C). The seeds in the refrigerator do **not** germinate. A student argues that the low temperature in the refrigerator kills the seeds and that explains why they do not germinate.
i) How could you check on this possibility? (1)
ii) State **ONE** reason why the seeds in the incubator germinate faster than those at room temperature. (1)

d. Seeds and fruit are dispersed away from the parent plant. Sketch a seed or a fruit that is adapted for dispersal by wind. Label with an **X** the special feature of the seed or fruit that helps in wind dispersal. (2)

(Total: 25 marks)

Please turn the page.

6. Soil is a fundamental natural resource. It provides many essential services on which we rely including food production, water management and support for valuable biodiversity and ecosystems. A soil with good infiltration combined with a high organic matter content, can utilise and store available water and reduce water runoff which causes flooding.

   a. Apart from rainfall, name **ONE** other factor that affects soil moisture in cultivated soil. (1)

   b. Give **ONE** effect for **each** of the following properties of organic matter:
      i) The typical dark colour of many soils; (1)
      ii) Organic matter is insoluble because it is associated with clay; (1)
      iii) Decomposition of organic matter releases carbon dioxide gas; ammonium, nitrate, phosphate and sulfate ions. (2)

   c. List **TWO** effects of the following statement:
      Organic matter groups soil particles together into structural units called aggregates. (2)

   d. Rain passes through the soil and porous rocks until it reaches impervious rocks on which it accumulates and forms the underground water table. Even in dry weather plants are able to absorb water from the soil, for water from this underground water table can be drawn upwards. This rise is due to capillarity.
      An experiment was set up to compare the capillarity in sandy soil and clay soil. The results of the experiment are shown below:

Time (hours)	Rise (m)	
	Clay	***Sand***
0	0	0
3	0.1	0.2
6	0.15	0.22
9	0.18	0.23
12	0.22	0.23
15	0.24	0.23
24	0.27	0.24
48	0.35	0.24
72	0.4	0.24

      i) On the graph paper provided (use the 2mm grid scale), plot a graph to show the rise (m) against time for clay. Join the points of the graph with straight lines. Plot time on the x-axis. (6)
      ii) Describe the results for **both** types of soil of this experiment. (4)

   e. i) Why do you think that humus is a source of food for plants? (2)
      ii) Give a reason why the colour of the soil changes after heating above 100°C. (2)

   f. A study was carried out to determine 'Rainwater infiltration under different types of management'. Soil infiltration is the soil's ability to allow water movement into and through the soil. Infiltration rate measures how fast water enters the soil i.e. depth of soil per hour.

The following table shows the results of the study.

Rainfall infiltration (mm)		
time (hours)	Soil management A	Soil management B
1	110	48
2	80	35
5	60	26
7	55	20

State **TWO** observations you can make from the results of this study. (4)

(Total: 25 marks)

7. a. As plants became more complex, the new species that evolved were less dependent on water.
   i) Define species. (2)
   ii) Give **TWO** explanations why mosses are highly dependent on water. (4)
   iii) Explain why certain species of fern, conifers and angiosperms can develop into trees. (2)

   b. An angiosperm, *Tiganophyton karasense*, was discovered in Western Namibia. The characteristics of this plant were so unique that it was also given the family name of Tiganophytaceae in the order of Brassicales. The flower has four small petals. The leaves are reduced.
   i) Is the plant a monocot or dicot? Give **ONE** reason for your answer. (1, 2)
   ii) List the scientific classification of this plant in the following order: Kingdom, Phylum, Class, Order, Family, Genus and Species (3)
   iii) DNA tests determined the classification of this organism. List **THREE** structural descriptions of a DNA molecule. (3)

   c. In an article on marine organisms, it was mentioned that certain fish hide from predators in sea anemones (cnidarians). Distinguish between fish and cnidarians. (4)

   d. Earthworms are considered as beneficial organisms to soil. List **TWO** roles of these organisms. (4)

(Total: 25 marks)

Please turn the page.

8. The following statements are incorrect. For **each** statement:
    - Explain why it is incorrect.
    - Write down the correct statement.

a. Blood pressure in the pulmonary artery is the same as the aorta. (4)

b. The components of urine of a person with healthy kidneys is urea, proteins, water and salts. (4)

c. In the human body, the role of lipid molecules is only in the structures of cell membranes. (4)

d. Endothermic organisms such as birds are unable to control their body temperature. (3)

e. The nervous system is a slow but sustained effect that has a short-term control over specific body parts. (6)

f. Plants take in all the substances they need to grow through their roots. (4)

(Total: 25 marks)