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SUBJECT: **Biology**  
 PAPER NUMBER: I  
 DATE: 26<sup>th</sup> August 2022  
 TIME: 9:00 a.m. to 11:05 a.m.

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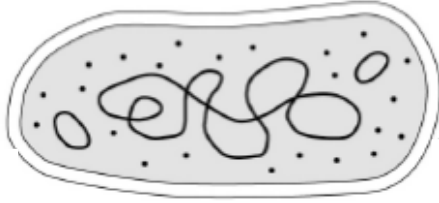
Answer **ALL** questions in this paper in the spaces provided.

1. Scientists use seven life processes to determine whether something is living or non-living.
- a. The following table, lists the life processes shared by all living organisms. Fill in the missing information in the table. (The first one has been done for you.) (6)

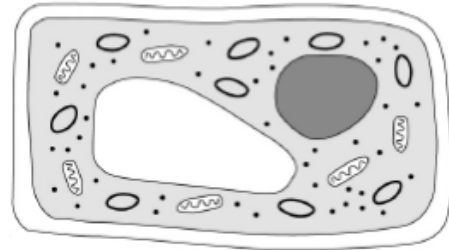
Life process	Description
Movement	An action by an organism or part of an organism causing a change of position or place.
	The chemical reactions in cells that break down nutrient molecules and release energy for metabolism.
	The ability to detect or sense stimuli in the internal or external environment and to make appropriate responses.
	Removal of waste products of metabolism including nitrogenous wastes, carbon dioxide and toxic substances.
Growth	
Reproduction	
Nutrition	

***This question continues on next page.***

- b. i) Figure 1.1 shows a prokaryotic cell and a eukaryotic plant cell. On the diagrams label **TWO** structures common to both cells. (Cells are not drawn to scale.) (2)



Prokaryotic cell



Eukaryotic plant cell

Figure 1.1: A prokaryotic and a eukaryotic plant cell  
 (Source: <https://pmt.physicsandmathstutor.com>)

- ii) In the table below list **TWO** differences between prokaryotic and eukaryotic cells. (2)

Prokaryotic	Eukaryotic

**(Total: 10 marks)**

2. Figure 2.1 below shows the flowers of 5 different species of plants, A – E, found living only in the Maltese islands.

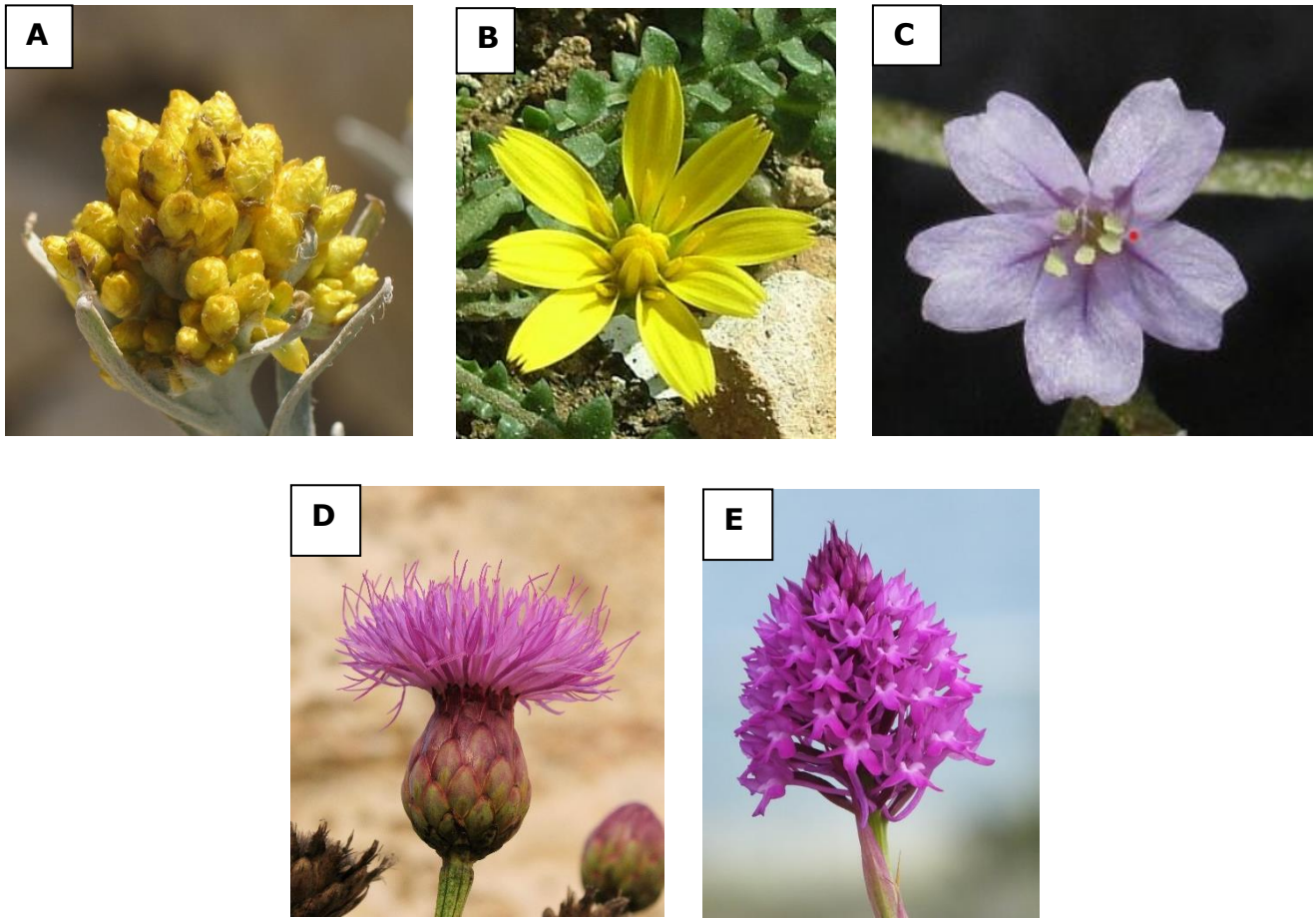


Figure 2.1: Flowers of 5 species of plants  
 (Sources: A, C - <http://www.maltawildplants.com>; B - <https://www.guidememalta.com>;  
 D - <https://top50.iucn-mpsg.org/species/22>; E - <https://www.greenhousengo.org>)

a. Using the key below determine the names of the plants **B**, **C** and **D**.

- |   |                          |
|---|--------------------------|
| 1. Flowers with clearly visible petals    | Go to 2                  |
| Flowers with petals not visible           | Go to 4                  |
| 2. Single flower                          | Go to 3                  |
| Many small flowers grouped together       | Maltese Pyramidal Orchid |
| 3. Petals in sets of four                 | Gozo Hyoseris            |
| Petals in sets of five                    | Zerafa’s Sea Lavender    |
| 4. Clusters of small ball like flowers    | Maltese Everlasting      |
| Large thistle like (funnel shaped) flower | Maltese Rock Centaury    |

B: \_\_\_\_\_

C: \_\_\_\_\_

D: \_\_\_\_\_ (3)

***This question continues on next page.***

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b. i) Name the phylum (or division) that these plants form part of.

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

ii) Give **ONE** reason for your answer.

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

c. The leaves of plant A are succulent and covered with small hairs while the leaves of plant E are long, thin with a parallel venation running along the length of the leaf.

i) Plant A grows on cliffs and garigue habitats. State how the characteristics of the leaves of plant A make it well adapted to the habitats where it grows.

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

ii) Name the sub-group of plants that have long leaves with parallel venation.

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

d. Write **ONE** characteristic of mosses.

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

**(Total: 10 marks)**

3. A student investigated the effect of temperature on the rate of breakdown of starch by the enzyme amylase. The student followed this procedure:

- The student placed 1 cm<sup>3</sup> of amylase in one test tube and 5 cm<sup>3</sup> of starch in a separate test tube.
- Both test tubes were placed in a water bath at 20°C for 5 minutes.
- The starch and amylase were then mixed.
- Using a pipette, she took samples from the mixture every 30 s.
- The student dropped the samples on iodine solution that was placed in the wells of a spotting tile.
- The process was repeated until no further colour changes were observed. This showed that all the starch had been digested.
- The procedure was repeated at different temperatures.
- The results obtained were tabulated, and the rate calculated using the formula 1/time.

Figure 3.1 below summarizes the procedure.

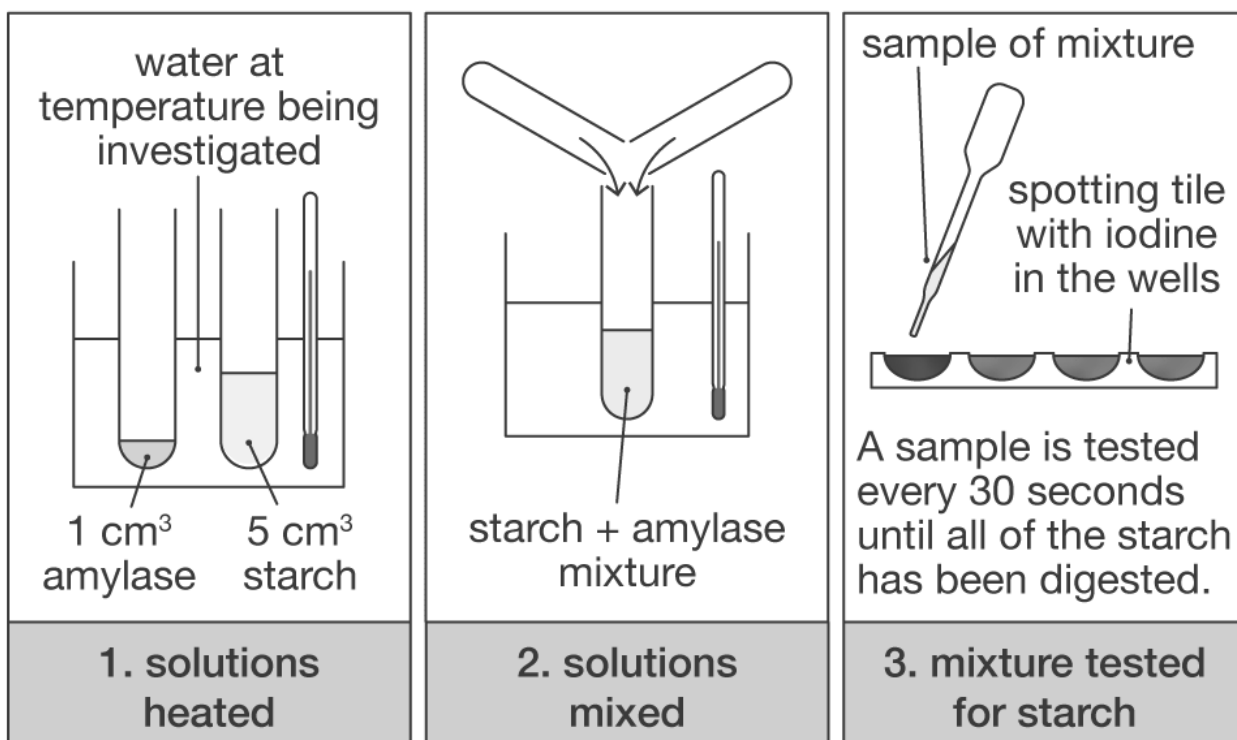


Figure 3.1: Procedure used to investigate the breakdown of starch by amylase at different temperatures  
 (Source: <https://www.lbq.org/filestoret>)

a. State the colour that the student observed in the wells with iodine solution when:

- i) starch was still present in the mixture; \_\_\_\_\_ (1)
- ii) starch was completely digested, and none was left in the mixture.  
 \_\_\_\_\_ (1)

***This question continues on next page.***

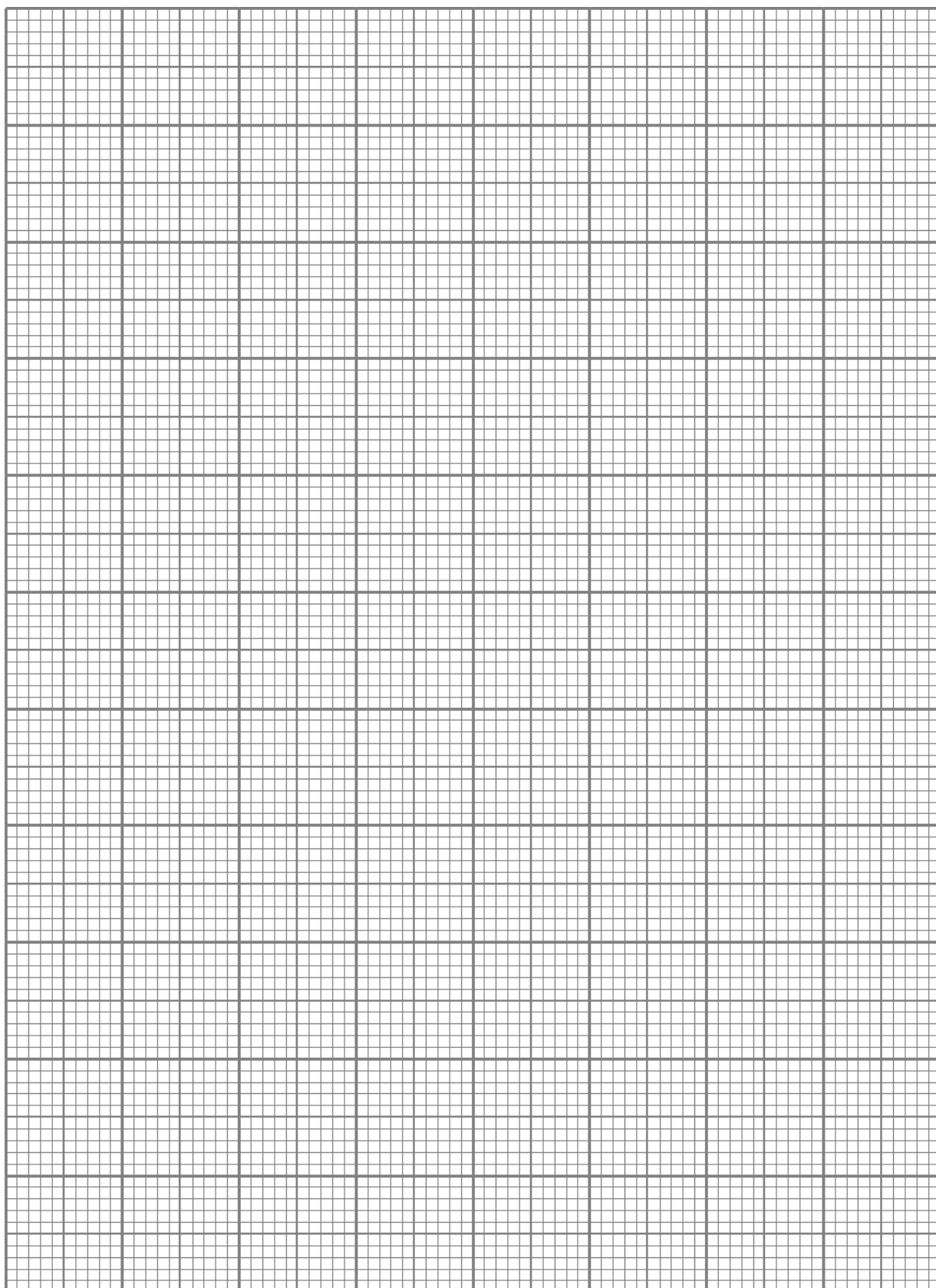
- b. Table 3.1 shows the results obtained in this experiment and the calculated rate of breakdown of starch by amylase:

Table 3.1 Time (in sec) taken for starch to be digested completely by amylase at different temperatures

<b>Temperature (°C)</b>	<b>Time for starch to be digested completely (s)</b>	<b>Rate of breakdown of starch (per s)</b>
20	540	0.002
30	270	0.004
35	180	0.005
40	240	0.004
45	480	

- i) In the space provided and using the formula  $1/\text{time}$ , calculate the rate of breakdown of starch by amylase at 45°C. Express your answer to three places of decimal and write it in the space provided in the table. (2)
- ii) Using the graph paper, plot a graph of rate of breakdown of starch (per s) against temperature (°C). Draw temperature on the x-axis. Join the points with a ruler. (4)

Title: \_\_\_\_\_



c. From the graph determine the optimum temperature for amylase. Give a reason for your answer.

Optimum temperature: \_\_\_\_\_

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

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

**(Total: 10 marks)**

4. Figure 4.1 shows the components of blood.

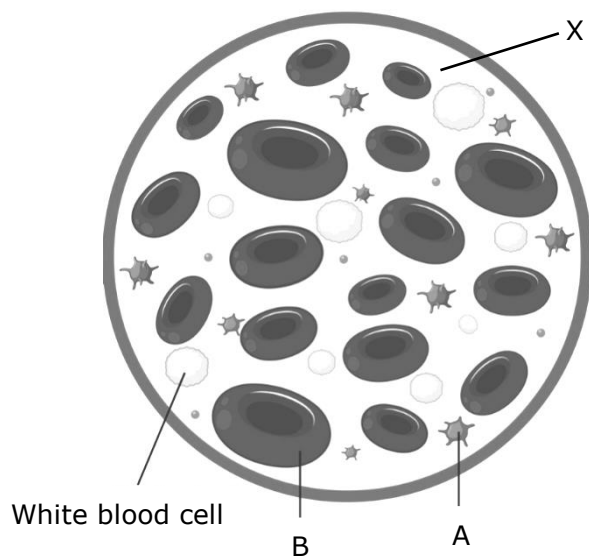


Figure 4.1: Blood components  
 (Source: <https://cdn5.vectorstock.com/i/1000x1000/38/29/composition-of-blood-diagram-vector>)

a. i) Label blood components A and B.

A \_\_\_\_\_ B \_\_\_\_\_ (2)

ii) State **ONE** structural feature of component B.

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

b. Leukaemia is a condition where the bone marrow produces abnormal white blood cells in large quantities.

i) One type of white blood cell is a phagocyte. Describe how a phagocyte performs its function.

\_\_\_\_\_  
 \_\_\_\_\_

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



ii) Explain how the production of abnormal white blood cells will impact the life of a human being.

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

c. Fluid X transports substances such as salts, proteins and hormones around the body.

i) Name blood component X.

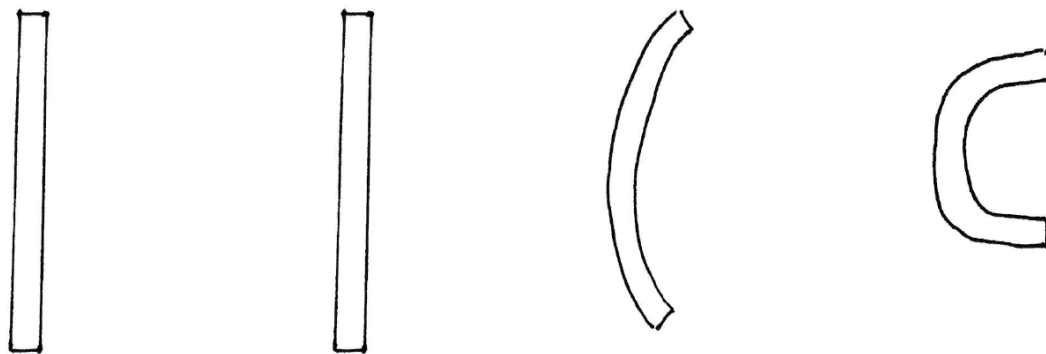
\_\_\_\_\_ (1)

ii) One hormone found in the blood is insulin. Explain why insulin is shed into the bloodstream after a person eats a meal.

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

**(Total: 10 marks)**

5. A group of students decided to observe the effect of different saline solutions on celery sticks. Below are three results obtained after the sticks were put in three different concentrations of salt solutions, A, B and C.



Shape of celery stick at the start

Shape of celery stick in solution A

Shape of celery stick in solution B

Shape of celery stick in solution C

Figure 5.1: Celery sticks in different saline solutions

a. i) Identify the solution having the same concentration of the cytoplasm of the cells of the celery stick. Give **ONE** reason for your answer.

Solution: \_\_\_\_\_ (1)

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

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

b. Celery stick C feels soft and is flaccid.

- i) How does the concentration of the salt solution compare to that of the cytoplasm of cells of the celery stick C?

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

- ii) Name the process that has made the celery stick soft and flaccid.

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

- iii) Explain why celery stick C is soft and flaccid.

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

c. Predict what happens if celery stick C is placed in pure water. Give a reason for your answer.

Prediction: \_\_\_\_\_  
\_\_\_\_\_ (1)

Reason: \_\_\_\_\_  
\_\_\_\_\_ (2)

**(Total: 10 marks)**

6. Organisms interact together in different ways.

- a. Table 6.1 lists 3 different interactions. In the space provided write a + if the individual benefits from the interaction or a - if the individual is harmed.

Table 6.1: Interactions between different organisms

Interaction	Organism	+ OR -
Parasitism	Host	
	Parasite	
Predation	Predator	
	Prey	
Competition	Stronger competitor	
	Weaker competitor	
Mutualism	Species 1	
	Species 2	
Herbivory (feeding relationship between herbivores and plants)	Herbivore	
	Plant	

(5)

- b. Table 6.2 describes different types of interactions between organisms. Using the list of interactions provided below, identify the type of interaction described and write it down in the space provided.

*intraspecific competition, interspecific competition, mutualism, predation, parasitism*

Table 6.2: Different types of interactions between organisms

Description	Interaction
Nitrogen-fixing bacteria provide leguminous plants with nitrogen compounds, whilst the plant provides the bacteria with sugars.	
The zombie wasp lays eggs in a cockroach. The larvae hatch and eat the tissues of the cockroach. The cockroach dies in the process.	
The Amazonian giant centipede hunts and kills a variety of other animals, including small snakes.	
Sharks, dolphins, and seabirds eat the same type of fish in ocean ecosystems.	
Male robins defend their territories and drive away other male robins that may enter their territory.	

(5)

**(Total: 10 marks)**

7. Figure 7.1 shows a process involving anaerobic respiration used to produce biogas.

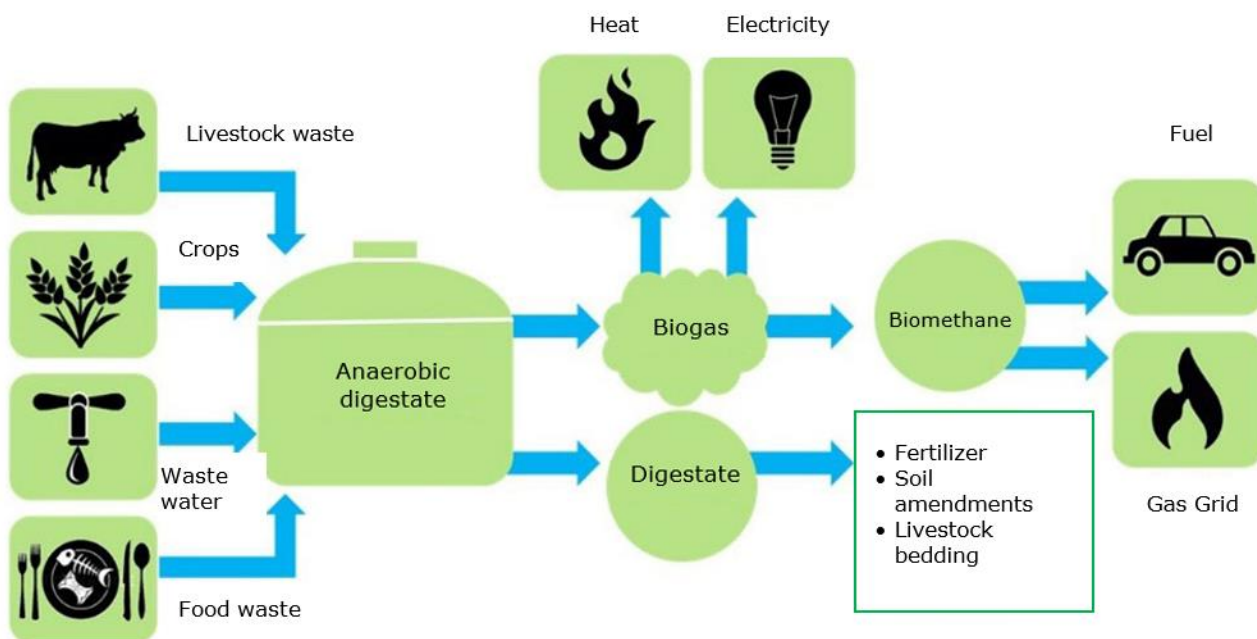


Figure 7.1: Anaerobic respiration process  
 (Source: <https://www.eesi.org/images/content/Figure1.jpg>)

a. The above process shows a waste-to-energy process. Use the flow diagram to explain why this is called a waste-to-energy process.

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

b. Distinguish between aerobic and anaerobic respiration.

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

c. Name **ONE** substance/nutrient present in the anaerobic digester that is the substrate of anaerobic respiration.

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

d. Biogas is made up of methane and another gas, the product of both aerobic and some types of anaerobic respiration.

i) Name the gas that is the product of both aerobic and anaerobic respiration.

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

ii) The energy released in aerobic and anaerobic respiration is used to form an energy-rich molecule. Identify this molecule.

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

e. Other than energy conversion, give **ONE** benefit of this process to the environment.

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

f. The fertiliser produced from the digestate may contain the minerals nitrogen and magnesium. State **ONE** function of each mineral.

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

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

**(Total: 10 marks)**

8. a. Figure 8.1 shows the external features of a leaf.

i) Label the following features on Figure 8.1: leaf blade, petiole, midrib, and vein. (2)

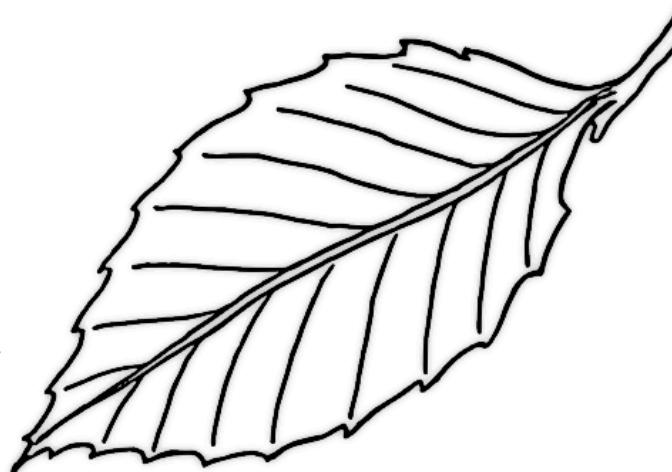


Figure 8.1: The external features of a leaf  
(Source: <https://media1.shmoop.com/images/biology>)

ii) Explain why a leaf with a broader leaf blade is expected to show a higher rate of photosynthesis.

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

iii) Explain why some plants have very small leaf blades.

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

***This question continues on next page.***

b. Figure 8.2 shows the internal structure of a typical leaf.

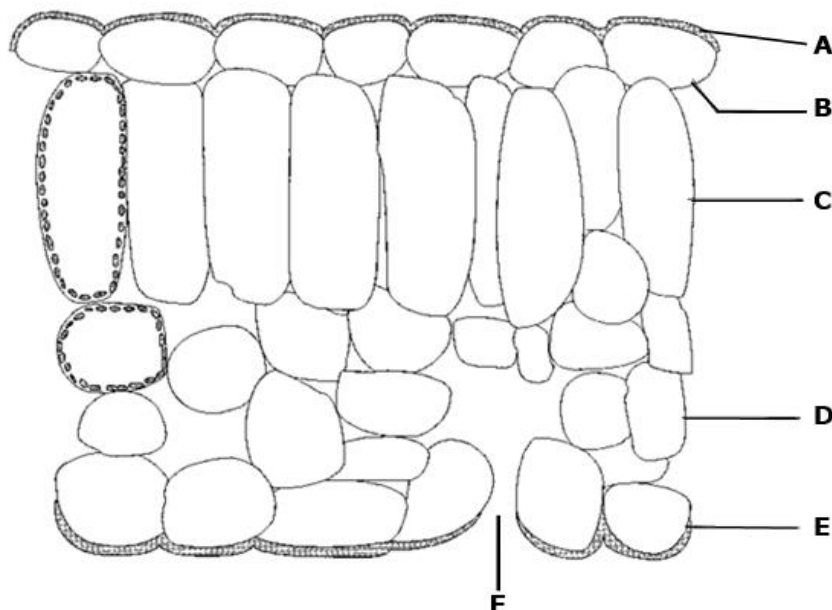


Figure 8.2: Cross section through a leaf  
 (Source: <https://www.researchgate.net/profile/Stephanie-Jacquemoud/publication>)

Use the letters in the diagram to identify **ONE** structure in the leaf that matches each observation listed in the table below.

Observation	Letter
Increases surface area for gaseous exchange.	
Is transparent to allow light through.	
Is generally absent in leaves that are below the water surface.	
Have the highest concentration of glucose during the day.	

(4)

**(Total: 10 marks)**

9. On first observation, soil may appear as a rather inert material where plants grow. On closer observation, one observes that soil is full of living organisms. These include bacteria, fungi, algae, protozoa, and a large variety of larger soil fauna such as nematodes, earthworms and insects that spend all or part of their life underground. Some organisms are beneficial to the soil while others are harmful.

a. i) Describe how earthworms help to mix organic matter in soil.

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(2)

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ii) State **TWO** other ways how earthworms are beneficial to soil.

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(2)

b. Garden millipedes feed only on decaying matter and consequently do not harm living plants unless the soil dries out to the point that the millipedes then feed on roots to obtain moisture.

i) State the effect that garden millipedes have on plants if they eat their roots. Give a reason for your answer.

Effect: \_\_\_\_\_

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

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(2)

ii) State **ONE** adaptation of millipedes and **ONE** adaptation of earthworms that enables them to live in the soil.

Millipedes: \_\_\_\_\_

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Earthworms: \_\_\_\_\_

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(2)

c. Several microorganisms live in the soil. They are not only found in the surface soil but also in subsurface soil at depths ranging from hundreds to thousands of metres below the ground.

Give **TWO** reasons why the number of microorganisms decreases with increasing depth in the soil profile.

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(2)

**(Total: 10 marks)**

10. In a day, the digestive system secretes around 7 litres of fluids. These fluids include/contain saliva, mucus, hydrochloric acid, enzymes, and bile.

a. Complete the following table by stating the role of each gut secretion.

Secretion	Role
Saliva	
Mucus	
Hydrochloric acid	
Enzymes	
Bile	

(5)

b. Figure 10.1 shows the human digestive system. Label the diagram to show where hydrochloric acid, saliva, bile, lipase, and pepsin can be found. (5)

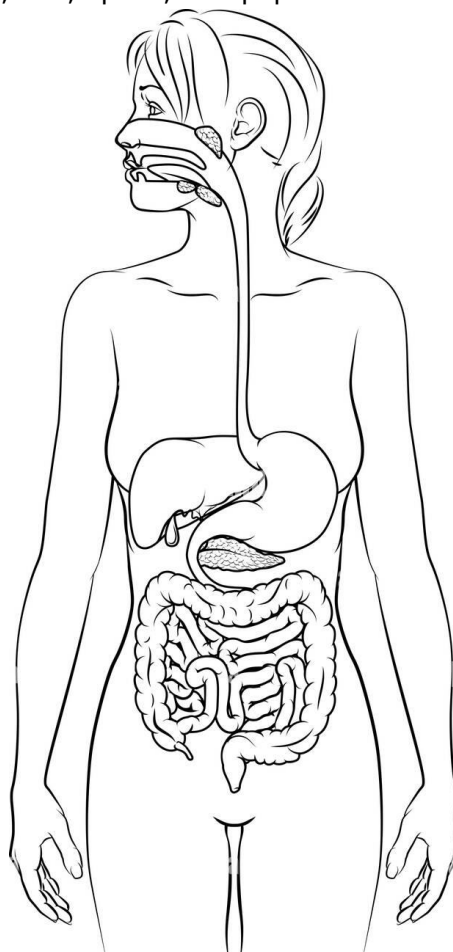


Figure 10.1: The human digestive system  
 (Source <https://c8.alamy.com/comp/2ACP2T1/human-digestive-system.jpg>)

**(Total: 10 marks)**






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SUBJECT:	<b>Biology</b>
PAPER NUMBER:	IIB
DATE:	26 <sup>th</sup> August 2022
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. Start a new page for each question that you answer. Please note that for question 5 of this paper you need the graph paper in the booklet.

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

1. a. The paragraph below describes a soil food web.

Nematodes feed on plant roots and on fungi and bacteria in soil. Bacteria and fungi eat and break down the organic leaf litter in soil. Soil protozoa and millipedes feed on the soil bacteria. Earthworms eat leaf litter, protozoa, and nematodes. Spiders and mites eat millipedes. Birds feed on earthworms, spiders, and mites. Hedgehogs eat spiders and mites.

- Draw a food web to describe the above feeding relationships. (6)
- Give an organism that is a quaternary consumer of this food web. (1)
- Name **ONE** organism that is a primary, secondary, and tertiary consumer. (1)
- A farmer adds pesticide to the soil. All the millipedes are killed by the pesticide. Predict how this will affect the nematodes and the hedgehogs in the food web. (2, 2)
- Some bacteria and fungi may be saprotrophs. Define a saprotroph. (1)
- Describe the role of saprotrophs in the soil. (2)
- Soil is defined as an ecosystem and a habitat. Distinguish between an ecosystem and habitat. (2)

- b. Figure 1.1 shows an aquatic food chain. The value under each organism shows the amount of energy available to the organisms at the next trophic level.



Figure 1.1: Aquatic food chain with energy values

- Using the values in Figure 1.1, calculate the percentage of shrimp's energy that is passed to the small fish. (2)
- Name the source of energy and the process through which plankton obtains its energy. (2)
- Name **TWO** processes in the small fish that will result in energy loss. (2)
- The number of medium-size fish is very small compared to the number of plankton in the food chain. Explain why. (2)

**(Total: 25 marks)**

2. Table 2.1 lists several animal species that live in the Maltese Islands.

Table 2.1: A list of several animal species in the Maltese Islands

Animal Group	Scientific name	Common English name
Molluscs	<i>Lampedusa imitatrix</i>	Maltese door-snail
	<i>Lampedusa melitensis</i>	Maltese door-snail
Fish	<i>Aphanius fasciatus</i>	Mediterranean killifish
Amphibians	<i>Discoglossus pictus</i>	Painted frog
Reptiles	<i>Caretta caretta</i>	Loggerhead turtle
	<i>Podarcis filfolensis</i>	Maltese wall lizard
Mammals	<i>Pipistrellus kuhlii</i>	Kuhl's pipistrelle
	<i>Plecotus austriacus</i>	Grey long-eared bat
	<i>Rhinolophus hipposideros</i>	Lesser horseshoe bat
	<i>Erinaceus algirus</i>	Algerian hedgehog
Other invertebrates	<i>Corallium rubrum</i>	Red coral

(Source: State of the Environment Report 2018, ERA, Chapter 8: Biodiversity)

Use the information in the table to answer the following questions:

- a. i) Give **TWO** characteristics that are common to all the species listed in the table that allow them to be classified in the animal kingdom. (2)
- ii) List the vertebrate groups that are listed in the table. (2)
- iii) Give **ONE** characteristic feature that the animals described as *other invertebrates* will share with the rest of the invertebrates. (1)
- iv) The Common pipistrelle and the Soprano pipistrelle belong to the same genus as the Kuhl's pipistrelle. Write down the genus name of these pipistrelles, in the correct scientific format. (2)
- b. Explain why the use of common English names to describe living organisms can be confusing. Support your answer with evidence from Table 2.1. (3)
- c. i) List **TWO** characteristics shared by all molluscs. (2)
- ii) The Red coral is a Cnidarian. Cnidarians only have one opening in their body, but molluscs have two. Explain this statement. (2)
- iii) List **TWO** differences between molluscs and annelids. (2)
- d. i) Compare the body covering of fish, amphibians, and reptiles. (3)
- ii) Fish are ectotherms whilst mammals are endotherms. Explain this statement. (2)
- iii) From Table 2.1 write the common English name of an organism that is expected to lay leathery eggs. (1)
- e. The Grey long-eared bat and the Lesser horseshoe bat both have wings to fly. Yet they are not classified as birds but as mammals. Give **THREE** reasons to support this classification. (3)

**(Total: 25 marks)**

3. *Cicada orni* is a species of cicadas found in the Mediterranean region including the Maltese Islands. The males of the species make loud buzzing sounds, during the days of the summer months, to attract females before courtship.
- a. The organisms of this species have an exoskeleton, three pairs of jointed limbs and two pairs of wings.
- i) State the phylum of the cicada species. (1)
  - ii) Write **ONE** structural characteristic of the phylum that includes the cicada species. (1)
  - iii) Give the class of the cicada species. (1)
- b. *Cicada orni* deposit their eggs in trees. Once these hatch, the cicada nymphs (larvae) move from the trees to the soil. Nymphs have an elastic exoskeleton. After three years, the nymphs emerge from the soil, climb trees, and shed their elastic exoskeleton and become adults. During this time their wings emerge.
- i) State **ONE** reason why nymphs have an elastic exoskeleton when they are in soil. (2)
  - ii) The exoskeleton becomes hard in adults. State the role of a hard exoskeleton. (1)
  - iii) Nymphs have piercing mouthparts that they use to suck up fluids from the roots' xylem and phloem. Distinguish between the contents of the fluid found in xylem and the contents of the sap found in phloem. (2)
  - iv) State the type of metamorphosis exhibited by the cicada. (1)
  - v) From the text, describe this type of metamorphosis. (3)
  - vi) The emergence of wings in the adult cicada is important. Give **TWO** reasons to explain this statement. (2)
- c. The adults of this species are found on woody trees including *Pinus halepensis* (Aleppo Pine) and the *Quercus ilex* (Evergreen Oak). The Aleppo Pine is a conifer while the Evergreen Oak is a dicot angiosperm. Distinguish between the leaf structure and the seeds of the two trees. (2)

In USA, there are other species of cicadas including the two species *Magicicada septendecim* and *Magicicada cassini*. These have a seventeen-year cycle and emerge from the soil in swarms (large numbers).

- d. A student wrote, "If a male *Magicicada septendecim* is crossed with a female *Magicicada cassini* fertile offspring is produced." State if the statement is correct and give **ONE** reason for your choice. (1, 2)
- e. Scientists suggest changes in the concentration of the plant root sap may indicate to the cicadas the years that pass. Explain why the concentration of plant root sap varies between the winter and summer months. (4)
- f. On emerging from soil, these cicadas may be attacked by a fungal parasite. The abdomen of cicadas gets invaded by the multicellular fungus.
- i) Name the fungal cells produced by asexual reproduction. (1)
  - ii) The infected cicadas still try to mate. Explain how this facilitates the transmission of the parasite. (1)

**(Total: 25 marks)**

4. Multicellular plants and animals developed systems of tubes and passageways to transport substances from one part of their body to another. Multicellular animals have also developed passageways to move, digest and absorb food into their internal environment.
- a. Explain why unicellular organisms have **not** developed transport or digestive systems. (2)
  - b. The transport tissues in plants are the xylem and the phloem.
    - i) Write a short note listing **TWO** structural differences between xylem and phloem. (2)
    - ii) Non-vascular plants lack xylem tissue. Explain how this affects the size of the plant and give a reason for your answer. (2)
  - c. Humans transport substances in blood through arteries, veins, and capillaries.
    - i) Draw labelled cross-sectional diagrams to compare the structure of the wall of an artery, the wall of a vein and the wall of a capillary. (9)
    - ii) A student wrote, "Substances in the transport tissues in plants travel inside cells, but blood travels inside organs." State if this statement is true and give a reason for your choice. (3)
  - d. Humans ingest food into the digestive system. As food travels through, it is digested, and the products formed are absorbed.
    - i) Name the process that moves food through the alimentary canal and describe how it occurs. (3)
    - ii) Products of digestion are absorbed in the ileum. Explain why the wall of the ileum is lined with villi. (2)
    - iii) Explain why plants do **not** have an alimentary canal where enzymes are released to digest food. (2)

**(Total: 25 marks)**

5. A group of students carried out an investigation into transpiration in a *Hibiscus rosa-sinensis* shoot. They wanted to find out whether the rate of transpiration of a plant shoot was different in the conditions inside the laboratory as compared to the conditions in the school playground. They used a potometer and recorded the movement of the liquid in the capillary tube and used this as a measure of the rate of transpiration.
- a. Draw a labelled diagram of a potometer. (4)
  - b. In each place, they recorded the air temperature, humidity of the air and wind speed. Their values are recorded in Table 5.1.

Table 5.1: Conditions inside the laboratory and outside in the playground

<b>Condition</b>	<b>Inside</b>	<b>Outside</b>
Humidity of the air (%)	46.0	67.0
Air speed in m/s	0.4	1.9
Air temperature in °C	25.0	18.0

- Draw **TWO** observations from the results shown in the table. (2)

- c. The students then set up the potometer in the laboratory and measured the distance moved by water in the capillary at one-minute intervals for 5 minutes. The apparatus was then taken outside, and the experiment was performed without delay. The results are recorded in Table 5.2 below.

Table 5.2: Distance moved by water in the potometer in different conditions

Time in minutes	Distance moved by water in mm	
	Inside	Outside
1	3	7
2	6	12
3	10	18
4	13	25
5	17	33

- i) Using the same axes, plot a graph to show how the distance moved by the meniscus varies inside and outside the laboratory over 5 minutes. Plot time on the x-axis. Join plots with a ruler. (6)
- ii) Draw **TWO** conclusions from the results of the investigation. (2)
- d. List **TWO** shortcomings of the design of the experiment. (4)
- e. Describe how the students can modify the experiment to create the following conditions inside the laboratory:
- i) air movements; (1)
- ii) blocked stomata; (1)
- iii) high temperatures. (1)
- f. Describe the effect of higher humidity on the rate of transpiration. Give a reason for your answer. (2)
- g. Describe **ONE** precautionary measure taken during the investigation. (1)
- h. State **ONE** way how a plant benefits from the transpiration stream. (1)
- (Total: 25 marks)**
6. a. A chromosome is made up of proteins and DNA (Deoxyribonucleic acid).
- i) Name the part of the cell that contains chromosomes. (1)
- ii) Describe the structure of DNA. (4)
- b. Sickle cell anaemia is a hereditary form of abnormal haemoglobin caused by a mutation in the gene that codes for haemoglobin in red blood cells. When red blood cells are produced with the abnormal haemoglobin, they have a sickle shaped cell as in Figure 6.1.

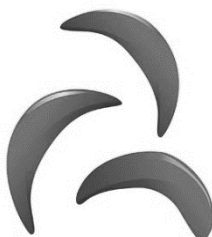


Figure 6.1: Sickle red blood cells due to abnormal haemoglobin

(Source <https://www.cdc.gov/ncbddd/sicklecell/features/what-is-scd.html>)

***This question continues on next page.***

- i) State the function of haemoglobin in red blood cells. (2)
- ii) Define the term mutation. (1)
- iii) Describe how the change in shape of the red blood cell affects its function. (2)

c. Figure 6.2 shows a pedigree of a family of which some members have sickle cell anaemia.

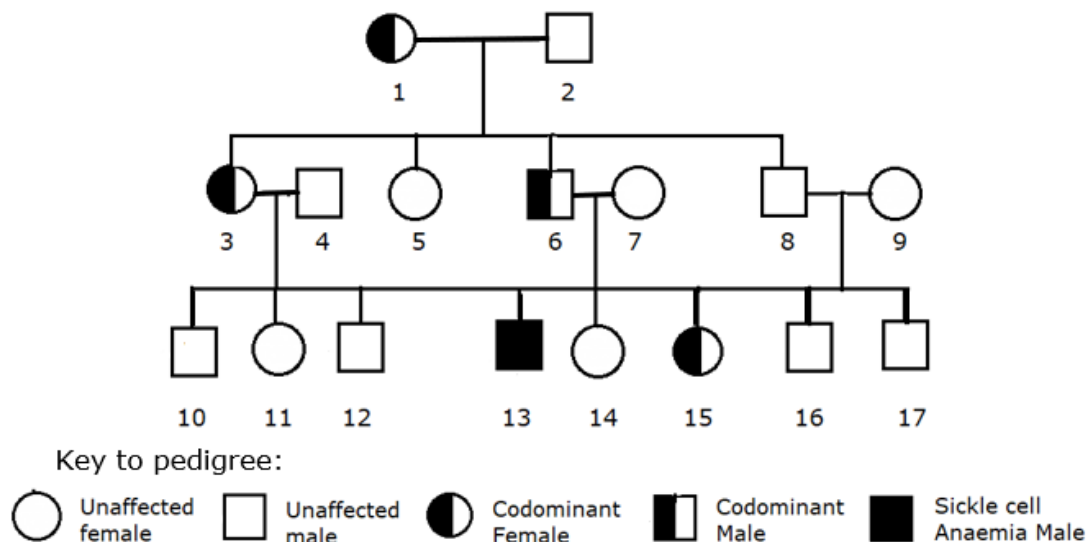


Figure 6.2: Pedigree of family

- i) The gene for sickle cell anaemia exhibits a codominant trait. Describe codominance. (1)
- ii) Describe the red blood cell phenotype of a codominant person. (2)

Use the symbols  $H^N$  for the allele determining normal haemoglobin and  $H^S$  for the allele determining abnormal haemoglobin.

- iii) Determine the genotype for person 7. Give a reason for your answer. (1, 2)
- iv) Using a genetic diagram, work out the probability that the person 10 will be a codominant male. (5)

d. A pet shop owner breeds golden fur and cream fur hamsters. The allele for golden coat (E) is dominant to the allele to the cream coat (e). The owner has a golden coat hamster of unknown genotype. Explain how the owner can determine the genotype of the golden fur hamster. (4)

**(Total: 25 marks)**

7. This question is about causes and effects of pollution.

- a. List **ONE** effect that pollution has on the environment. (1)
- b. Human activities have led to the pollution of land and water. Pollution comes from a variety of sources including industry and manufacturing processes, waste and discarded rubbish, chemicals from farming practices and untreated sewage. Identify the source/cause and describe the effect of the following pollutants:
  - i) untreated sewage; (2)
  - ii) chemical waste; (2)
  - iii) discarded rubbish; (2)
  - iv) fertilisers. (2)

- c. A modern landfill is a popular method used to dispose of solid waste today. Modern landfills are built using a layering system designed to safely isolate waste and monitor any by-products, leaks, and anything else that can harm the environment. Isolating the waste from air and water is vital for preventing contamination.
- i) Nitrates from waste in the landfill can leach down into and pollute the ground water below the landfill. Propose a way how this may be avoided. (2)
  - ii) When the landfill is full, light solid wastes such as plastic bags can be moved by strong winds to other areas. Propose a way how this may be avoided. (2)
  - iii) Describe **ONE** advantage and **ONE** constraint of this solid waste management. (2)
- d. The fashion industry around the world generates over 92 million tonnes of waste every year. This waste generally ends up in landfills and takes decades to decompose. Explain how the following may help in reducing the amount of waste generated by the fashion industry:
- i) Some influencers suggest 'go for quality instead of quantity' when buying clothes. (2)
  - ii) Renting a suit instead of buying one when attending a wedding. (2)
  - iii) Repairing torn clothes. (2)
  - iv) Purchasing vintage clothing. (2)
- e. In an incinerator, solid wastes are burnt at high temperatures until they are turned into ashes.  
Suggest **ONE** advantage and **ONE** disadvantage of using an incinerator instead of a landfill to dispose of solid waste. (2)

**(Total: 25 marks)**

8. This question is about the human urinary system.

a. Name:

- i) the exact location in the kidney where nephrons are found; (1)
- ii) the exact location where urine collects inside the kidney; (1)
- iii) the structure where urine is stored temporarily; (1)
- iv) the tube that carries urine away from a kidney. (1)

b. Selective reabsorption occurs in the proximal (first) convoluted tubule of the nephron. Explain how the following characteristics of the tubule allow efficient selective reabsorption:

- i) the proximal (first) convoluted tubule is long and folded; (2)
- ii) the cells lining the tubule have a lot of microvilli; (1)
- iii) the cells lining the tubule have a lot of mitochondria; (1)
- iv) the distance between the proximal convoluted tubule and the capillaries surrounding is very short. (1)

c. The kidney filters blood. The fluid which is filtered passes along a tubule in the nephron where some of the substances are absorbed back into the blood. The fluid which remains is urine.

***This question continues on next page.***

Table 8.1 shows the concentration of different substances in blood, in filtered fluid and in urine. The units of concentration are in mg per litre.

Table 8.1 The concentrations of different substances in different body fluids / mg per l

Substance/Fluid	Blood plasma	Filtered fluid	Urine
Urea	0.4	0.4	20.0
Glucose	1.5	1.5	0.0
Amino acids	0.8	0.8	0.0
Salts	8.0	8.0	16.5
Proteins	82.5	0.0	0.0

Use the information in the table to:

- i) list the substances that are filtered out of the blood into the nephron; (2)
- ii) list the substances that are absorbed from the tubule back to the blood; (2)
- iii) explain the result obtained for proteins. (2)

d. An investigation was carried out to determine the effect of drinking excessive amounts of water on urine flow. Urine was collected 3 times, at 10-minute intervals, from a subject. The subject then drank one litre of water at time marked zero. Urine output was measured every 10 minutes and the results were recorded in the graph in Figure 8.2 below.

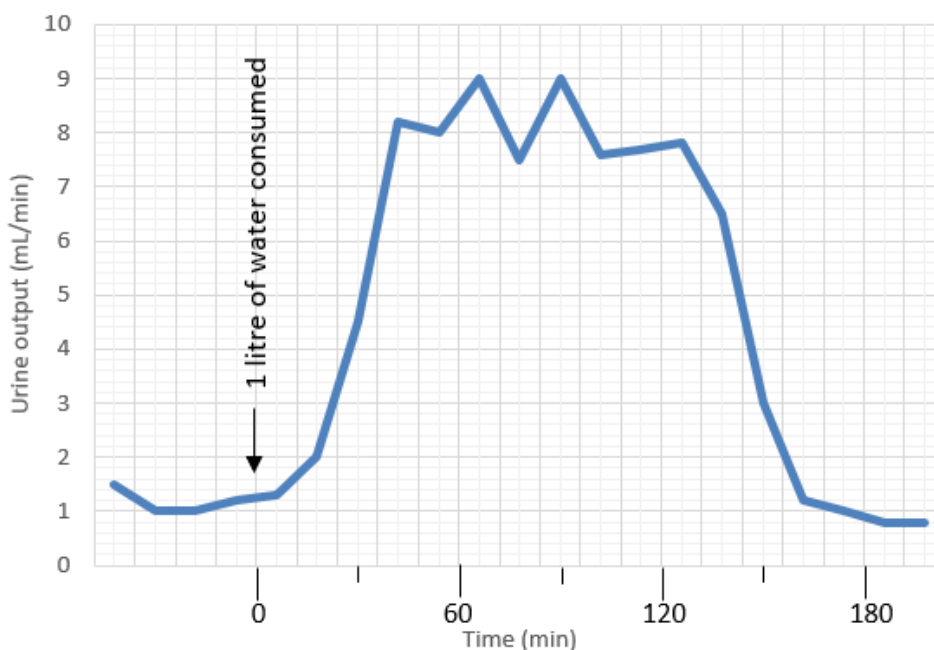


Figure 8.2: Graph showing the urine output (mL/min) against time (min)

(Source: adapted from <https://www.nysmigrant.org>)

Use the information in the graph to determine the:

- i) urine output at the beginning of the investigation; (1)
- ii) maximum rate of urine output during the experiment; (1)
- iii) time taken to reach the maximum rate of urine output; (1)
- iv) time taken for the subject to get rid of the excess water. (1)

e. A student states that 'urine output is equal to water intake.' State if the statement is correct and write a note explaining your reason. (1, 5)

**(Total: 25 marks)**