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SUBJECT: **Biology**  
 PAPER NUMBER: I  
 DATE: 6<sup>th</sup> May 2024  
 TIME: 4:00 p.m. to 6:05 p.m.

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**Directions to candidates**

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** questions. Write all your answers in the spaces provided.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated in brackets.
- You are reminded of the necessity for orderly presentation in your answers.
- The use of electronic calculators is permitted.

**For examiners' use only:**

Question	1	2	3	4	5	6	7	8	9	10	Total
Score											
Maximum	10	11	10	10	10	10	10	10	9	10	100

1. This question is about herbivore and carnivore digestive systems.

a. In what way is the digestive system of a herbivore similar to that of a carnivore?

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

b. Carnivore digestive system has a single stomach with a rather short digestive tract. Describe how this digestive system is different from the digestive system of a herbivore. Give a reason for your answer.

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

c. The dentition of a herbivore can easily be distinguished from that of a carnivore. List **FOUR** differences between the dentition of the two types of animals. (4)

Herbivore Dentition	Carnivore Dentition

d. 'Rabbits have a special kind of digestion called hind gut fermentation. They produce two types of droppings: black faecal pellets and cecotropes (softer dark, greenish-brown pellets). Rabbits consume the cecotropes as they exit the anus. This function is similar to cows chewing their cud'. Explain.

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

**(Total: 10 marks)**

2. Figure 2.1 shows the rate of photosynthesis and rate of respiration of a plant.

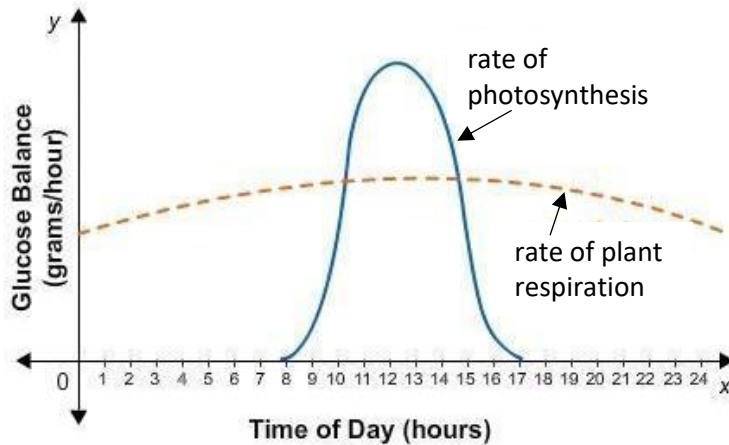


Figure 2.1: Rate of photosynthesis and rate of respiration of a plant  
(Source: <https://brainly.com/question/16545941>)

a. Explain why the rate of photosynthesis increases and decreases during one day.

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(2)

b. Explain why the rate of respiration varies slightly during the day.

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(3)

c. Figure 2.1 shows two compensation points. Using your biological knowledge, explain in terms of carbohydrate balance why these two compensation points occur during one day.

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(3)

d. At the maximum point of the rate of photosynthesis graph, some factor is limiting the increase in the rate of photosynthesis.

i) Name a limiting factor at maximum rate of photosynthesis.

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(1)

ii) Describe why the factor mentioned in part (d.) (i) is limiting.

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(2)

**(Total: 11 marks)**

3. Table 3.1 shows the results obtained in an investigation on the effects of increasing width of stomatal pore on the rate of transpiration. Results were obtained for two plants, one put in an area with no air currents (still air) and the other in air currents (moving air).

Table 3.1: Results of investigation

Width of stomatal pore µm (micrometres)	Rate of transpiration (arbitrary units)	
	Still air	Moving air
0	0	0
3	30	30
6	50	50
9	60	140
17	70	225
21	70	275

(Source: <https://www.tes.com/>)

- a. Give **ONE** other abiotic factor that affects transpiration.

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

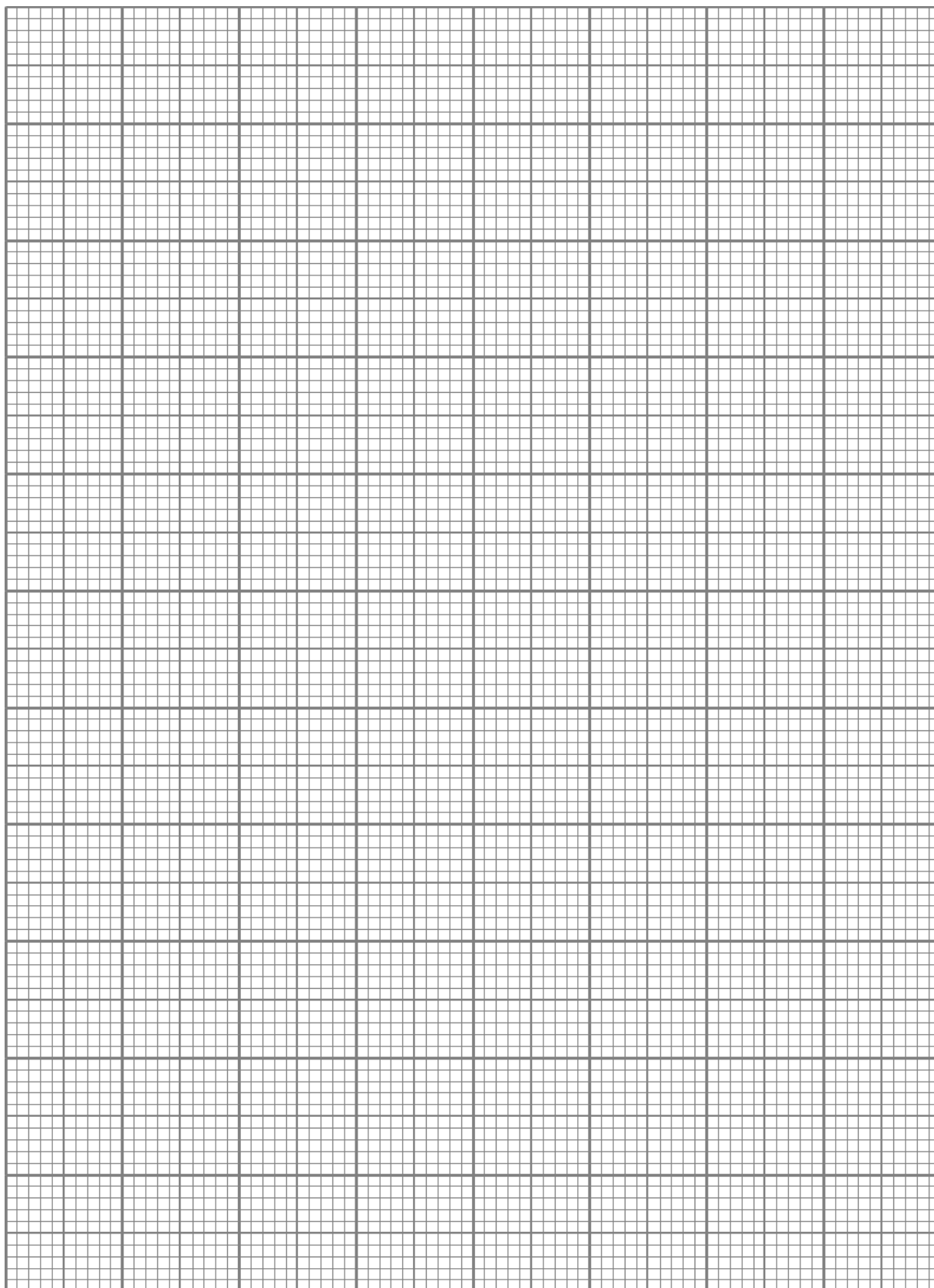
- b. Using the graph paper provided on the next page, plot a graph of the rate of transpiration (arbitrary units) in moving air against the width of stomata pore (micrometres). Join the points with a ruler. (4)

- c. Describe the trend of rate of transpiration in still air, by referring to the results in Table 3.1.

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

- d. Give a biological explanation, for the difference in rate of transpiration between still air and moving air, at a stomatal pore width of 21 µm.

\_\_\_\_\_ (4)



**(Total: 10 marks)**

***Please turn the page.***

4. A new endemic species, named *Limonium lanfrancoi* (Lanfranco's Sea Lavender), has been discovered in October 2023. This flowering plant is only found in a small area within the Maltese archipelago and is unique to the world. It has a very restricted distribution on the Maltese Islands, and it is considered an endangered species. Thus, it is strictly protected in Malta.

The *Limonium lanfrancoi* is a small woody shrub living along a very narrow coastal limestone rocky strip. It shows close relationships with another coastal flowering shrub unique to the Maltese Islands, the *Limonium melitense* (Maltese Sea Lavender).

A scientific publication also provides a detailed analysis of four different sea lavender species identified in Malta, including their conservation status. This analysis includes a third endemic sea lavender, the *Limonium zeraphae* (Zerapha's Sea Lavender).

New species often develop in isolated environments, where they change to adapt to the specific environment. The next step for this research is to study the genetic makeup of the plant, as plants that thrive in extreme environments such as the rocky coasts of Malta, can provide important insight and help increase the hardiness of crop plants, as the changing climate becomes more extreme.

(Adapted from: <https://www.um.edu.mt/newspoint/news/2023/11/newly-identified-endemic-plant-limonium-lanfrancoi>)

- a. i) What do *Limonium melitense*, *Limonium lanfrancoi* and *Limonium zeraphae* have in common?

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

- ii) Explain why it is advantageous for biologists to use the binomial nomenclature.

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

- b. State a reason for **not** disclosing the exact location of the new endemic species.

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

- c. *Limonium lanfrancoi* has been declared an endemic species. Define the term *species*.

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

- d. 'New species often develop in isolated environments, where they change to adapt to the specific environment'. How are plants adapted to develop in harsh conditions?

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

e. 'Research will be carried out to study the genetic makeup of the plant. Plants that thrive in extreme environments such as the rocky coasts of Malta, can provide important insight and help us increase the hardiness of crop plants, as the changing climate becomes more extreme'. Explain this statement.

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(3)

**(Total: 10 marks)**

5. Bees are considered as the best pollinators. However, in recent years beekeepers have reported colony losses.

a. With reference to the flower, state where bees take pollen and where they deposit it.

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(2)

b. List **TWO** effects of bee population decline.

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(2)

c. List **TWO** possible causes of bee population decline.

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(2)

d. List **TWO** ways that countries can adopt to save bees from further decline.

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(2)

e. Describe the flowers pollinated by bees.

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(2)

**(Total: 10 marks)**

***Please turn the page.***

6. This question is about biological molecules. Fill in the following table:

Table 6.1: Biological molecules

	<b>Carbohydrates</b>	<b>Fats (solid), oils (liquid)</b>	<b>Proteins</b>
<b>Elements</b>		C, H, O	
<b>Example</b>	Glucose	Phospholipid	
<b>Smallest unit</b>			
<b>Larger molecules</b>	Polysaccharides	----- None-----	Polypeptides
<b>Function</b>		Heat insulation	
<b>Chemical test</b>	For Glucose:	Translucency: greasy spot on a filter paper	

**(Total: 10 marks)**

7. a. Fill in the blanks in the following paragraph about the mammalian respiratory system.

The \_\_\_\_\_ are a mammal’s organs of gaseous exchange. Air entering the nose and mouth passes via the \_\_\_\_\_, trachea, bronchus and \_\_\_\_\_, finally reaching the tiny air sacs, called the \_\_\_\_\_. The trachea and bronchus are held permanently open by incomplete rings of \_\_\_\_\_, are lined with tiny hair-like \_\_\_\_\_ and glandular cells which secrete sticky \_\_\_\_\_. The air sacs are the site of gaseous exchange. Before diffusion, oxygen dissolves in the moisture of the thin lining. Diffusion occurs as there is a \_\_\_\_\_ \_\_\_\_\_ from the air in the lungs to the blood in the capillaries. (4)



b. Figures 7.1 A and B show the respiratory organs of an insect and a fish respectively.

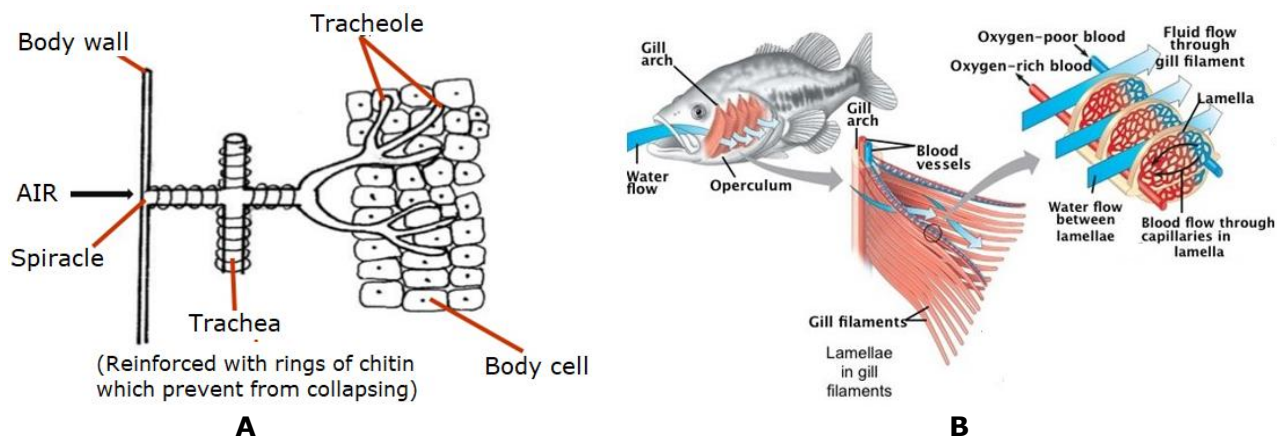


Figure 7.1 – Gaseous exchange surface of an insect (A) and a fish (B)  
 A - <https://as-studypeach.tumblr.com/post/172004171854/savol-ratios-gas-exchange-in-insects>  
 B - <https://www.quora.com/The-passage-of-blood-and-water-in-fish-gill>

i) From the diagram name the structure within each respiratory system where gaseous exchange occurs.

Insects: \_\_\_\_\_ (1)

Fish: \_\_\_\_\_ (1)

ii) List **TWO** reasons why diffusion of oxygen occurs at both these structures.

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

iii) State **ONE** characteristic of respiratory surfaces that is **not** present in insects and explain why gaseous exchange still occurs efficiently.

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

**(Total: 10 marks)**

8. Leigh’s Disease is a rare mitochondrial disease in children caused by an inherited mutation.

a. Name **ONE** organ that has numerous mitochondria within its cells.

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

b. Name a molecule that is oxidised to produce chemical energy.

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

**Please turn the page.**

c. How is the chemical energy produced by mitochondria, stored?

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

d. Mitochondria are large enough to be seen by the light microscope.

i) Name **ONE** other organelle that can be viewed through a light microscope.

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

ii) List **TWO** steps that a biology student needs to take while using the light microscope, to achieve a focused image of a cell slide.

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

e. Mitochondria are organelles present in 'most' eukaryotes. Name:

<b>ONE</b> organelle present in plant cells and <b>not</b> in animal cells;	
<b>ONE</b> organelle present in all eukaryotes.	

(1, 1)

f. Write the term that describes organisms that lack membrane bound organelles.

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

g. A mutation is a permanent change in the DNA sequence of an organism. Small amounts of DNA can be found in the mitochondria. Name the organelle where most of the DNA is located in eukaryotic cells.

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

**(Total: 10 marks)**

9. In the animal kingdom, primitive invertebrates such as the sea anemone have a decentralized nervous system without a brain. *Planaria* have a simple brain. Octopus have a complex brain while vertebrates have a brain located in the head.

a. A sea anemone is a cnidarian (coelenterate), *Planaria* is a plathyhelminth and an octopus is a mollusc. Other than the absence or presence of a brain:

i) Distinguish between organisms of the phylum cnidaria and the phylum mollusca.

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

ii) State **ONE** characteristic of plathyhelminthes.

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

b. Figure 9.1 shows the structure of the human brain.

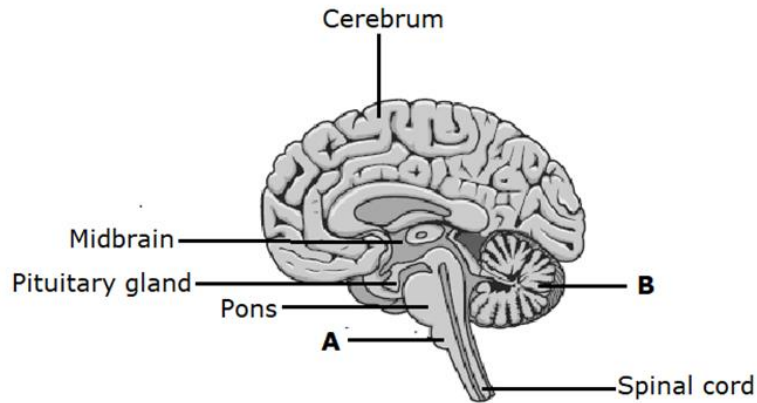


Figure 9.1: Cross-section of the brain

(Source: <https://www.sarthaks.com/35522/>)

i) Label parts A and B.

A \_\_\_\_\_ B \_\_\_\_\_ (1, 1)

ii) State **ONE** function of the cerebrum.

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

c. Studies have showed that chemicals in coffee may protect brain cells from deterioration which lead to neurodegenerative diseases such as Alzheimer’s. Such protection allows the release of chemicals (neurotransmitters) between the neurones for communication.

i) Name the site of transmission from one neurone to another.

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

ii) Describe what will happen when the released chemical arrives to the other neurone.

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

d. The spinal cord carries information to and from the brain to various organs and effectors. Reflex actions impulses travel to the spinal cord but **not** up to the brain. Explain why.

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

**(Total: 9 marks)**

***Please turn the page.***

10. The human blood type gene comes in three different alleles A, B and O. The table below lists the six different blood types in human beings.

Table 10.1: Genes and blood types in human beings

<b>Genes</b>	AA	AO	BB	BO	AB	OO
<b>Blood type</b>	A	A	B	B	AB	O

a. Write the blood type that is the result of two co-dominant alleles.

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

b. State which blood type allele is recessive.

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

c. In a family of five, the three daughters Ann, Shakira and Keira have the following blood types.

Table 10.2: Blood types of daughters

<b>Daughter</b>	Ann	Shakira	Keira
<b>Blood type</b>	A	O	B

i) List the **TWO** possible genotypes of the parents.

Parent 1: \_\_\_\_\_ Parent 2: \_\_\_\_\_ (1, 1)

ii) Write the **TWO** genotypes for Ann and Keira.

Ann: \_\_\_\_\_ Keira: \_\_\_\_\_ (1, 1)

iii) Give the percentage chance that a fourth child in the family would have blood type O.

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

d. Shakira and her partner Tom have two children John and Ben. John has blood type B while Ben has blood group A.

i) State the genotype of Tom.

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

ii) State the genotype of Ben.

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

iii) Work out the percentage chance that a third child of Shakira and Tom would have blood type A.

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

**(Total: 10 marks)**




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SUBJECT:	<b>Biology</b>
PAPER NUMBER:	IIA
DATE:	7 <sup>th</sup> May 2024
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.

**The good, bad and essential: microbes that affect food and health**

When Professor Tom Gilbert and his colleagues were researching how different diets affect chickens in 2019, something strange happened: one batch of chicks grew much more slowly than in two previous trials. This was despite the chickens living in the same highly controlled environment with identical diets and food supplements.

The only possible difference was that the chicks had been exposed to unidentified microbes on their journey from the hatchery in Catalonia to Denmark. The microbes that the chicks ingested would have been part of the vast array of microorganisms – including bacteria, fungi and viruses – that exist in the environment, people and animals, called the microbiome.

Microbes present in the environment colonise the gut of an animal as soon as it is born, creating a community teeming with trillions of both beneficial and potentially harmful bacteria, viruses and fungi. The microbiome of a person or an animal has a big influence on health, affecting growth and immune responses and regulating nutrient intake.

Meanwhile, microbes in plants and soil affect crop growth and resilience. Beneficial microbes could also ease the environmental impact of farming by reducing the need for fertilisers, antibiotics and other chemicals.

Helped by advances in DNA sequencing that shed greater light on microbial communities, this study, named HoloFood, laid the ground for a better understanding of the impact of food substances and supplements on the microbiome and – ultimately – on animal health. This type of research could eventually aid the development of sustainable food production.

Understanding microbial communities could help make other forms of food production – such as the cultivation of crops – more sustainable too. In another study, named SIMBA, the researchers investigated how microbes affect growth and resistance to certain diseases or environmental conditions like drought. The researchers found that inoculating *Arabidopsis* plants – often used as model organisms – with a mix of four particular microbe species resulted in increased drought tolerance. This hints at a potential to improve resistance in other crops too.

They identified further microbial mixes that aided the growth of wheat – perhaps through enhancing the uptake of nitrogen – and that improved the yield of potatoes grown in salt marshes.

The implications for harnessing seawater for irrigation in areas of the world unsuitable for cultivation are potentially significant. Projects like HoloFood and SIMBA have opened up the field for future research into how microbes can make food production healthier and better for the planet.

(Adapted from: <https://projects.research-and-innovation.ec.europa.eu/>)

- a. Explain why the chicks involved in the HoloFood research were all kept in the same controlled environment. (2)
  - b. Bacteria, fungi and viruses are all identified as microbes.
    - i) State **ONE** structural difference between bacteria and viruses. (1)
    - ii) Write **ONE** structural similarity between fungi and viruses. (1)
    - iii) Give **ONE** structural similarity between bacteria and unicellular fungi. (1)
    - iv) State **ONE** structural difference between bacteria and fungi. (1)
  - c. Name **ONE** other group of unicellular organisms **not** mentioned in the text. (1)
  - d. Using your biological knowledge, give **ONE** description of how beneficial microbes can reduce the need of fertilisers. (2)
  - e. Explain why the name of the plant, *Arabidopsis*, is written in this form. (1)
  - f. Plants resist disease by having barrier mechanisms and through producing certain chemicals. Humans resist disease through action of white blood cells. Name **ONE** type of white blood cell and describe how it attacks microbes that entered the body. (1, 1)
- (Total: 12 marks)**

2. A study was carried out to investigate the recovery profile after two different exercise intensities. Two healthy males, person **A** and person **B**, cycled for 8 min at two separate intensities: Low and High. The heart rate was monitored at 1-minute intervals during 10-minute seated recovery, immediately after exercise.

The results for person A are presented in the table below.

Table 2.1: Recovery Profile at two different exercise intensities for person A

Recovery Period (min)		0	1	2	3	4	5	6	7	8	9	10
Heart rate at intensities: (beats min <sup>-1</sup> )	Low	115	78	70	68	68	65	65	65	65	65	65
	High	170	140	125	105	105	102	100	99	98	96	95

(Source: <https://www.researchgate.net/>)

- a. Draw a graph to show the results of the investigation. Plot the Recovery Period on the horizontal axis. Join points with straight lines. (6)
- b. i) Heart rate recovery refers to the decrease in heart rate 1 minute after exercise. Calculate the heart rate recovery at low intensity. (1)
- ii) After doing the same physical activity for the same period of time, a gym instructor noticed that the recovery period of person **A** was shorter than that of person **B**. List **ONE** reason for such an observation. (1)
- c. Explain why, apart from the increase in heart-beat rate, the breathing rate during exercise also increases. (4)
- d. State **ONE** conclusion that you draw from the results of this study. (1)

**(Total: 13 marks)**

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

3. Each year a number of endangered or threatened species are lost to extinction.
- a. Define the term extinction. (2)
  - b. Among the species lost were birds, mammals and reptiles.
    - i) State **ONE** common characteristic between the three groups. (1)
    - ii) Bats are mammals. Give **TWO** characteristics of this group. (2)
    - iii) List **TWO** differences between birds and reptiles. (2)
    - iv) The bats (mammals) and birds that became extinct all lived in forests that ultimately become agricultural land. Name the type of land misuse in this example. (1)
  - c. The San Marcos Gambusia from the San Marcos river in Texas, US is one species of fish that has become extinct. These fish ate a type of insect larva and other invertebrates. These fish gave birth to live young.
    - i) State which characteristic of this species is **not** normally a characteristic of fish and explain why. (1, 1)
    - ii) Describe **TWO** characteristics of fish that make it highly adapted to the water environment fish live in. (2)
    - iii) Explain the term insect larva. (2)
    - iv) Draw a food web of the organisms found in San Marcos river from the information below: (6)  
 Snails and mussels feed on aquatic plants. Zooplankton and insects (including larva) feed on autotrophic biofilm (group of microorganisms). The Largemouth Bass feeds on three species of fish: the Fountain Darter, Texas Shiner and Redear Sunfish. Zooplankton and insects (including larva) are prey to both Fountain Darter and Texas Shiner. Wading birds feed on the Largemouth Bass and Texas Shiner and Fountain Darter. The Redear Sunfish feed on snails, mussels and insects (including larva).  
 (Source: [studylib.net/doc/7132325/san-marcos-river-food-web](http://studylib.net/doc/7132325/san-marcos-river-food-web))
  - d. Each year new species are also discovered and described. In 2023, 619 new species of wasps (insects) were described. Also, in the same year a new species of spider namely, the Giant Crab Spider, was discovered. The class arachnida includes spiders.
    - i) Name the common phylum of wasps and spiders. (1)
    - ii) List **TWO** characteristics of this phylum. (2)
    - iii) Give **ONE** distinguishing feature between wasps and spiders. (2)

**(Total: 25 marks)**

4. Transporting food from Earth to the International Space Station has always been a problem. Moreover, the food transported needs to be freeze-dried and prepacked. NASA is therefore researching, the idea of fresh produce in space, critical to health during long duration missions.
- a. One main challenge is vitamin deficiencies as vitamins in prepacked food deteriorates quickly over time.
    - i) Name **ONE** vitamin needed by the human body. (1)
    - ii) Describe the effects of lack of this vitamin on the human body for the vitamin stated in part (a) (i). (2)

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

Within the Earth's NASA research centre, researchers are trying to produce vegetables and fruit under environmental conditions found in space. The major challenge is a closed environment without sunlight or Earth's gravity. In the space lab the plants are grown in 'pillows' which help distribute water, nutrients and air in a healthy balance around the roots.

- b. i) Name the process in plants that needs light and describe why this process needs light. (1, 2)
- ii) State **TWO** reasons why this process may be beneficial to the air environment within the space station. (4)
- c. i) Explain the importance of Earth's gravity in terms of shoots and roots. (3)
- ii) Explain what would happen if the plants were surrounded with too much water. (2)
- iii) In the absence of gravity researchers are also using light to orient and guide growth. Using your biological plant knowledge explain why and how this happens. (1, 3)
- iv) Name **ONE** mineral needed by plants and explain its purpose. (1, 1)

All the plants grown in the space lab are dicotyledons.

- d. i) List **TWO** distinguishing factors between dicotyledons and monocotyledons. (2)
- ii) State **ONE** type of habitat needed for mosses to grow in a space lab and give **ONE** reason why this type of habitat is important for mosses. (1, 1)

**(Total: 25 marks)**

5. A group of biology students conducted an experiment to investigate which type of soil is best suited for a rugby pitch to allow adequate drainage. The students were provided the following items:

3 measuring cylinders, 3 filter funnels, 3 sheets of filter paper, 3 different types of soil, water

- a. Using the items listed above describe the method you would use to conduct the investigation. (8)
- b. Clay soil has a high proportion of fine small particles while sandy soil has a high proportion of large particles.
- i) Compare the spaces in clay and sandy soils. (2)
- ii) Compare the water holding capacity of clay and sandy soil. (2)
- iii) Which type of soil, clay soil or sandy soil, is more difficult to plough? Give **ONE** reason for your answer. (1, 1)
- iv) Which type of soil, clay soil or sandy soil warms up quickly in spring? (1)
- v) Which type of soil, clay soil or sandy soil, cracks easily? (1)
- c. In some areas around Malta there are only shallow soils. Explain the plant limitations caused by shallow soils. (4)
- d. A group of biology students are collecting fruit scraps, vegetable scraps, dry leaves and finely chopped bark chips to start composting. They are stirring (mixing) the compost pile once a week. Explain the importance of stirring. (3)
- e. Farmers prefer using mulches in their fields. Mulches are loose coverings or sheets of material placed on the soil surface. List **TWO** benefits of mulching. (2)

**(Total: 25 marks)**



6. People whose kidneys do not function properly may be treated with a dialysis machine. Blood from an artery in the arm is circulated through thin-walled dialysis tubing bathed in a special solution made up of water and dissolved substances. This solution is similar to blood plasma but lacks certain substances such as protein and urea. The blood coming out from the dialysis machine returns to a vein in the arm.

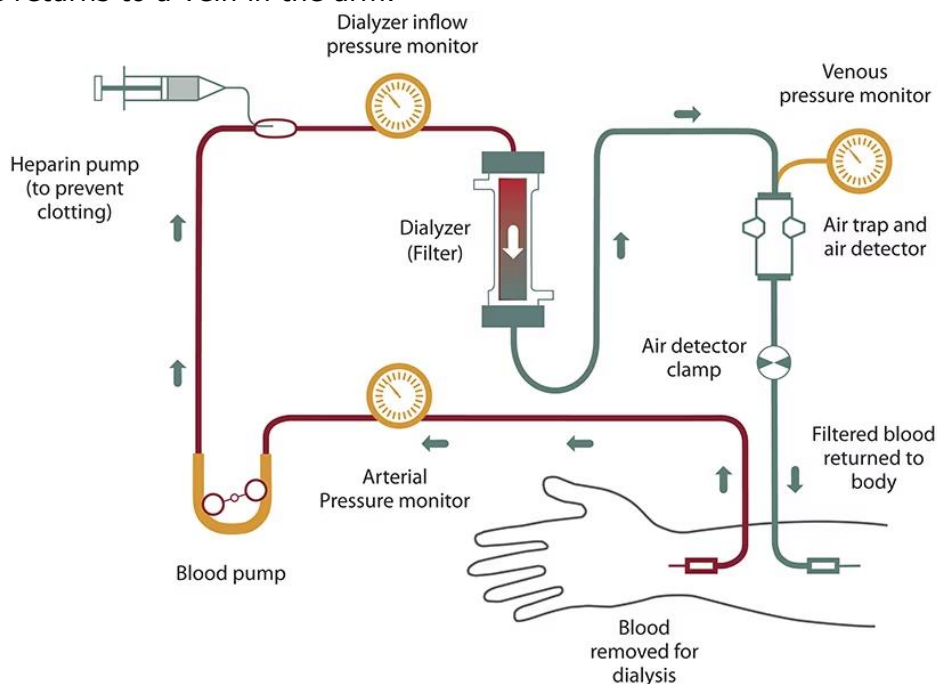


Figure 6.1: Haemodialysis

(Source: <https://www.niddk.nih.gov/>)

- a. i) Explain in detail how the process of dialysis works. (5)
- ii) Explain why glucose is one of the dissolved substances present in the dialysis fluid, while proteins are **not**. (2)
- iii) A dialysis machine performs some of the functions of a human kidney. The human body maintains water and electrolytes concentration at a relatively constant level. Explain in detail how the body acts to conserve its water content in the kidney when water intake is low or water loss is high. (5)
- b. In an investigation, a drop of blood was placed on each of three microscope slides. On slide A, the blood was mixed with 0.35% salt solution. On slide B, the blood was mixed with 0.85% salt solution. On slide C, the blood was mixed with 5% salt solution. The salt concentration in blood plasma is 0.85%. All three slides were observed under the microscope. Explain what happens to the red blood cells in solution A, solution B and solution C. (6)
- c. Along the nephron, a dense network of capillaries surround the tubules that carry the waste (filtrate). Substances such as glucose, amino acids and vitamins that the body needs from the waste are reabsorbed into the blood stream. Often, the concentration of nutrients in the blood is higher than the concentration of nutrients in the waste. Explain how the reabsorption of substances from the waste into the blood is possible. (4)
- d. Cells take up substances by either diffusion, osmosis or active transport.
  - i) Describe the similarities between diffusion and osmosis. (2)
  - ii) Describe how osmosis and active transport are similar. (1)

**(Total: 25 marks)**

**Please turn the page.**

7. Give a biological explanation for **each** of the following statements about reproduction:

a. Sexual reproduction in plants is highly beneficial. (5)

b. Flowers are well-adapted to carry the reproductive functions in angiosperms. (5)

c. Mammalian sex is genetically determined by the combination of the X and Y chromosomes. (4)

d. Meiosis is the start of sexual reproduction in human beings. (4)

e. The diaphragm is a barrier method of artificial family planning. (3)

f. The progesterone levels in a pregnant female and a non-pregnant female are different. (4)

**(Total: 25 marks)**




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SUBJECT:	<b>Biology</b>
PAPER NUMBER:	IIB
DATE:	7 <sup>th</sup> May 2024
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 6 of this paper you need the graph paper in the booklet.

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

1. Each year a number of endangered or threatened species are lost to extinction.
  - a. Define the term extinction. (2)
  - b. Among the species lost were birds, mammals and reptiles.
    - i) State **ONE** common characteristic between the three groups. (1)
    - ii) Give **ONE** characteristic of birds. (1)
    - iii) List **TWO** differences between mammals and reptiles. (2)
    - iv) The mammals and birds that became extinct all lived in forests that ultimately become agricultural land. Name the type of land misuse in this example. (1)
  - c. The San Marcos Gambusia from the San Marcos river in Texas, US is one species of fish that has become extinct. These fish ate small mosquito larva and other invertebrates. These fish gave birth to live young.
    - i) State which characteristic of this species is **not** normally a characteristic of fish and explain why. (1, 1)
    - ii) Describe **TWO** characteristics of fish that make it highly adapted to the environment fish live in. (2)
  - d. The information below describes the interaction of organisms that live in the San Marcos river.

Snails and mussels feed on aquatic plants. Zooplankton and large invertebrates feed on autotrophic biofilm (group of microorganisms). The Largemouth Bass feeds on three species of fish: the Fountain Darter, Texas Shiner and Redear Sunfish. Wading birds feed on the Largemouth Bass and Texas Shiner and Fountain Darter. Zooplankton and large invertebrates are prey to both Fountain Darter and Texas Shiner. The Redear Sunfish feed on snails, mussels and large invertebrates.

(Source: [studylib.net/doc/7132325/san-marcos-river-food-web](https://studylib.net/doc/7132325/san-marcos-river-food-web))

From the text, identify **ONE**:

- i) tertiary consumer. (1)
  - ii) autotrophic organism. (1)
  - iii) herbivore. (1)
  - iv) producer. (1)
- e. Using the information given, draw a food chain with four trophic levels. (2)

**Please turn the page.**

- f. Each year new species are also discovered and described. In 2023, 619 new species of wasps (insects) were described. Also, in the same year a new species of spider, the Giant Crab Spider was discovered. Wasps and spiders all have jointed appendages.
- Name the common phylum of wasps and spiders. (1)
  - List **ONE** characteristic of this phylum **not** mentioned in the above text. (1)
  - Wasps have 3 pairs of jointed appendages while spiders have 4 pairs of jointed appendages. Give the class of wasps and the class of spiders. (1, 1)
- g. In some cases, scientists discovered organisms in new habitats. Different species of protists were found in the gut of mice and humans.
- Describe a protist organism. (2)
  - Name an animal-like protist and describe how this organism traps food. (1, 1)

**(Total: 25 marks)**

2. European research in recent years, has focused on the effect of microbes in the digestive system of animals and the effect of microbes on plants.

- a. In a particular research, on how different diets affect chickens, one group of chicks grew slower than the other groups. The conclusion to this was that the chicks were exposed to microbes such as bacteria, fungi and viruses during transport.
- From the microbes in the text above, identify which **ONE**:
    - is **not** cellular;
    - can be multicellular;
    - always** creates a parasitic relationship. (1, 1, 1)
  - Write **ONE** structural similarity between fungi and viruses. (1)
  - Write **ONE** structural similarity between bacteria and fungi. (1)
  - State **ONE** structural difference between bacteria and fungi. (1)
  - Viruses are known to reproduce only within a host cell. Describe the reproduction of a virus. (4)
  - Bacteria reproduce rapidly. Name the type of asexual reproduction that bacteria commonly use and describe the process of this type of reproduction. (1, 3)
- b. All groups of chickens used in the research were kept in the same highly controlled environment with identical diets and food supplements. Explain why the chicks were all kept in the same controlled environment. (2)
- c. Microbes in plants and soil affect crop growth and resilience. Examples of microbes in the soil are nitrifying bacteria and saprophytic fungi. Describe the role of each of the two microbes mentioned. (2, 2)
- d. Drought (lack of rain resulting in water shortage) is the result of global warming. Describe global warming using the following terms. (5)
- greenhouse gas emissions; trapping the heat; infrared rays; absorb; increase.

**(Total: 25 marks)**

3. A group of biology students conducted an experiment to investigate which type of soil is best suited for a rugby pitch. The students were provided with the following items:

3 measuring cylinders, 3 filter funnels, 3 sheets of filter paper, 3 different types of soil, water.

- a. i) List **TWO** variables that need to remain unchanged during the investigation. (2)
- ii) State which measurement is needed by the students to be able to draw a scientific conclusion in this investigation. (2)
- b. Clay soil has a high proportion of fine (small) particles while sandy soil has a high proportion of large particles. Name the type of soil (clay soil or sandy soil):
  - i) with a low water holding capacity; (1)
  - ii) with small spaces; (1)
  - iii) that is difficult to plough; (1)
  - iv) that warms up quickly during spring; (1)
  - v) that cracks easily. (1)
- c. Describe **ONE** way how to increase the water holding capacity of soil. (2)
- d. In some areas around Malta there are only shallow soils. Explain how this affects the plants' roots and plant growth. (3)
- e. List **TWO** benefits of each of the following practices:
  - i) removal of weeds; (2)
  - ii) some farmers leave a piece of farmland uncultivated for some time; (2)
  - iii) use of terraces on sloped land; (2)
  - iv) covering the soil with a cover of decaying leaves. (2)
- f. In crop rotation, legumes are one type of crop cultivated in the same field. Legumes are considered as a biological source of nitrates (nitrogen). Explain. (3)

**(Total:25 marks)**

4. Transporting food from Earth to the International Space Station has always been a problem. Moreover, the food transported needs to be freeze-dried and prepacked. NASA is therefore researching the idea of fresh produce in space critical to health during long duration missions.

- a. Scientists are studying crops that are dicots. List **THREE** differences between monocots and dicots. (3)

Within the Earth's NASA research centre, researchers are trying to produce vegetables and fruit under environmental conditions found in space. The major challenge is a closed environment without sunlight or Earth's gravity. In the space lab the plants are grown in 'pillows' which help distribute water, nutrients and air in a healthy balance around the roots.

- b. i) Name the process taking place in plants that needs light. (1)
- ii) Name a gaseous chemical needed for this process to occur. (1)
- iii) Name a gaseous product of this process. (1)
- iv) Using the two gases stated in parts b ii) and b iii), explain why this process may be beneficial in an enclosed environment with humans present. (3)

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

- c. The Earth’s gravity is a stimulus to plants which brings about a geotropic response.
- i) Describe the effect of gravity on the roots of plants. (2)
  - ii) Roots also grow towards water. Explain the importance of this response. (2)
  - iii) Explain what would happen if the plant’s roots were surrounded with too much water. (2)
- d. In the absence of gravity, researchers are also using light to orient and guide growth. Light is also a stimulus to plants. When a plant is put in a box with unilateral light, the plant shoot grows towards light.
- i) Name the chemical that brings about the above-mentioned response. (1)
  - ii) Explain how the plant bends towards light. (4)
- e. NASA also has environment programmes for students to identify sources of Earth’s pollution and research pollution in the country that they live in.
- i) List **ONE** land pollutant. (1)
  - ii) Name **ONE** source of the pollutant mentioned in part (e.) (i) (1)
  - iii) State **ONE** water pollutant. (1)
  - iv) Name **ONE** source of the pollutant mentioned in part (e.) (iii) (1)
  - v) Describe **ONE** effect of this pollutant. (1)

**(Total: 25 marks)**

5. a. The following diagram shows red blood cells as seen under the microscope.

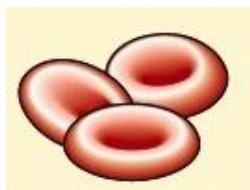


Figure 5.1: Diagram of red blood cells

Cells are placed in three different salt solutions, A, B and C. Solution A is a higher concentration than the cytoplasm of the red blood cells, Solution B is the same concentration as the cytoplasm of the red blood cell while solution C is less concentrated than the cytoplasm of the red blood cells. After some time, the cells appeared as in the following diagrams:

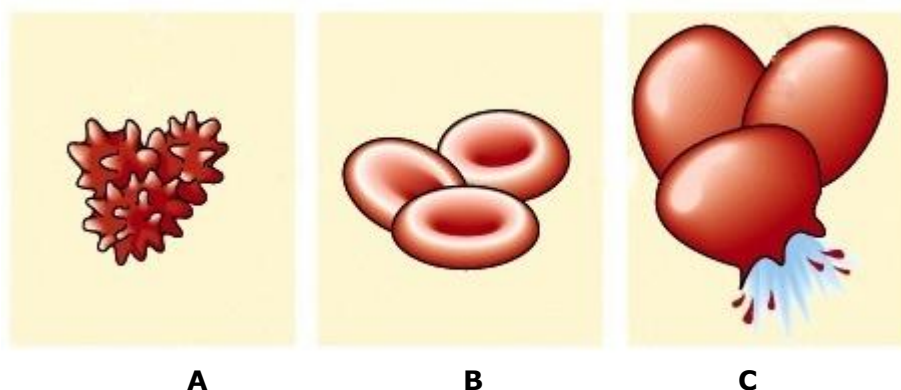


Figure 5.2: Cells in different salt solutions

(Source: <https://quizlet.com/gb/293069329/cell-biology-osmosis-in-animal-cells-diagram/>)

Explain, giving reasons, what happened to the red blood cells after placing them in the three different salt solutions: A, B and C. (6)

b. If one or both kidneys fail then dialysis is used to keep urea and solute concentration in the blood constant.

Blood from an artery in the arm is circulated through thin-walled dialysis tubing bathed in a special solution made up of water and dissolved substances. This solution is similar to blood plasma but lacks certain substances such as protein and urea. The blood from the dialysis machine returns to a vein in the arm.

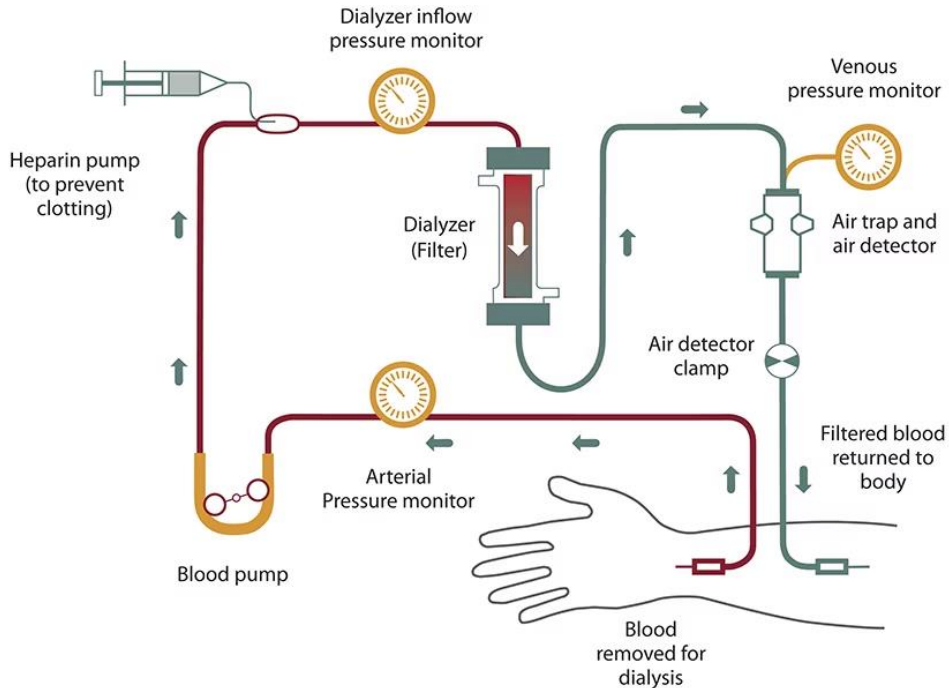


Figure 5.3: Haemodialysis

(Source: <https://www.niddk.nih.gov/health-information/kidney-disease/kidney-failure/hemodialysis>)

- i) Explain what happens to the blood from the time it enters the dialysis machine until it leaves. (5)
- ii) Explain why glucose is present in the dialysis fluid before blood passes through the thin-walled tubes in the machine. (2)
- iii) A dialysis machine performs some of the functions of a human kidney. The human body maintains water and electrolytes concentration at a relatively constant level. Explain in detail how the body acts to conserve its water content in the kidney when water intake is low or water loss is high. (5)
- iv) Although dialysis is lifesaving, a kidney transplant has advantages when compared to dialysis. Give **THREE** advantages of a kidney transplant. (3)

c. Cells take up some substances that they need by active transport. How does active transport differ from osmosis? (4)

**(Total 25 marks)**

***Please turn the page.***

6. A study was carried out to investigate the recovery profile after two different exercise intensities. Two healthy males cycled for 8 min at two different intensities: Low and High. The heart rate was monitored at 1-minute intervals during 10-minute seated recovery, immediately after exercise. The results of a male are presented in the table below:

Table 6.1: Recovery Profile at two different exercise intensities of a male

Recovery Period (min)		0	1	2	3	4	5	6	7	8	9	10
Heart rate at intensities: (beats min <sup>-1</sup> )	Low	115	78	70	68	68	65	65	65	65	65	65
	High	170	140	125	105	105	102	100	99	98	96	95

(Source: <https://www.researchgate.net/>)

- Draw a graph to show how the heart beat rate at high intensity, changes over the recovery period. Plot the Recovery Period on the horizontal axis. Join points with straight lines. (6)
- Heart rate recovery refers to the decrease in heart rate 1 minute after exercise. Calculate the heart rate recovery at low intensity and at high intensity. (2)
- Give **ONE** conclusion that can be drawn from the results of this study. (1)
- After doing the same physical activity for the same period of time, the recovery period of Joe was shorter than that of Philip. How might Joe be different from Philip? (1)
  - During exercise, apart from an increase in heart-beat rate, the breathing rate also increases. Explain. (4)
- When oxygen arrives to muscles, the body cells perform aerobic respiration. In terms of energy converted, distinguish between aerobic and anaerobic respiration. (2)
  - Anaerobic respiration in muscles is a result of an oxygen debt. Explain. (3)
  - Name the molecule that is produced by muscles during anaerobic respiration. (1)
  - What will happen to the molecule mentioned in part (e.) (iii) after exercise. (3)
  - List **TWO** uses of energy in living processes. (2)

**(Total: 25 marks)**

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

- Gymnosperms have **no** flowers. (2)
- The diaphragm is an artificial family planning method. (4)
- There is **no** genetic variation through mitosis. (2)
- The Y chromosome is present in males but **not** in females. (5)
- In most mammals, fertilization is internal but in amphibians it is external. (3)
- The Luteinizing Hormone is produced in both girls and boys. (4)
- The freshwater organism *Hydra* and the fungus Yeast both produce by budding. (5)

**(Total: 25 marks)**



8. An experiment was carried out to investigate the effect of temperature on respiration in yeast. A mixture consisting of yeast, sugar and water was mixed very well. 10 cm<sup>3</sup> of the mixture was transferred into each of 6 test tubes. Care was taken to ensure that no foam formed on the surface during the transfer. The test tubes were placed in water baths at different temperatures. After 30 minutes, the test tubes were removed from the water baths and the height of the foam that developed on the surface of the liquid, measured. The results are shown in the table below.

Table 8.1: Effect of temperature on respiration in yeast

Test tube number	Temperature in °C	Height of foam in mm
1	10	0.5
2	20	5
3	30	14
4	40	26
5	50	12.5
6	60	3.5

- a. Explain why a gas has been given off causing the foam in the test tubes. (3)
- b. Describe the way how the students would measure the height of the foam. (3)
- c. Some students suggested drawing a graph to show the results of the experiment. Make a drawing to show the axes they would have used for their graphs. Include the scale and label for each axis. Do **not** plot the results or use a graph paper. (4)
- d. i) Give the importance of mixing the yeast, sugar and water solution. (2)  
 ii) From the introduction, state **ONE** other precaution of this investigation. (1)
- e. Describe **TWO** ways how the experiment could be improved and give a reason for each improvement listed. (4)
- f. Some students believe that a repeat of the experiment can give them better results on which to base their conclusion. List **TWO** reasons why repeating an experiment can provide better results. (2)
- g. What conclusion can you draw from the results in this experiment? (3)

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

- h. The following table shows how the rate of respiration changes according to the substrate used.

Table 8.2: Rate of respiration per substrate

<b>Carbohydrate substrate</b>	<b>Rate of respiration (cm<sup>3</sup> of CO<sub>2</sub> per minute)</b>
Glucose	5.3
Sucrose	3.1
Starch	0.5
Lactose	1.2

Use the table to suggest which substrate is the best for the yeast. Explain your answer in terms of energy conversion. (3)

**(Total: 25 marks)**