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SUBJECT: **Biology**  
 PAPER NUMBER: I  
 DATE: 9<sup>th</sup> May 2022  
 TIME: 4:00 p.m. to 6:05 p.m.

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

1. Figure 1.1 shows three cubes A, B and C. Cube A has sides of 1 cm; cube B has sides of 2 cm while cube C has sides of 3 cm.

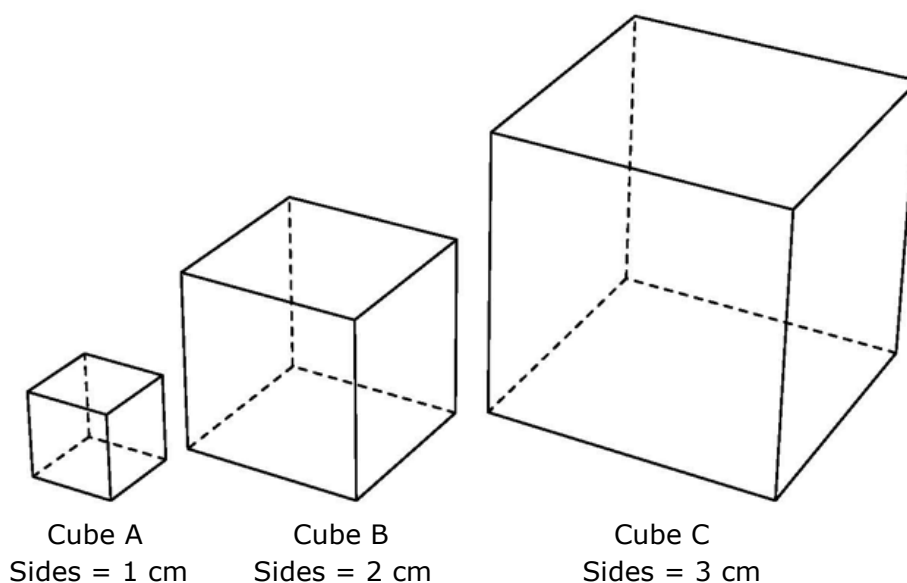


Figure 1.1 Cubes A, B and C

(Source: <https://freight.cargo.site/t/original>)

- a. Fill in the table below by calculating the surface area, volume, and surface area to volume ratio of cube C. The calculations for cubes A and B are worked out.

| Cube | Surface Area (cm <sup>2</sup> ) | Volume (cm <sup>3</sup> ) | Surface Area: Volume ratio |
|------|---------------------------------|---------------------------|----------------------------|
| A    | 6                               | 1                         | 6:1                        |
| B    | 24                              | 8                         | 3:1                        |
| C    |                                 |                           |                            |

(3)

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

b. Use the trend in the SA:V ratio in comparison to cube size to explain why:

- i) unicellular organisms such as *Amoeba* receive an adequate supply of oxygen by diffusion across the cell membrane.

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

- ii) Platyhelminthes (flatworms) have evolved to have flat, thin bodies.

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

c. Large multicellular organisms have systems in their body to allow exchange of substances.

Cells became specialised for specific systems.

- i) Explain the meaning of the phrase 'specialised for specific systems.'

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

- ii) Name **ONE** specialised cell and describe its specialisation.

Cell: \_\_\_\_\_ (1)

Specialisation: \_\_\_\_\_ (1)

**(Total: 10 marks)**

2. DNA is an important biological molecule.

- a. What type of biological molecule is DNA?

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

b. Write the name of:

- i) the structures carrying DNA in a cell; \_\_\_\_\_ (1)

- ii) a section of DNA controlling an identifiable characteristic; \_\_\_\_\_ (1)

c. Distinguish between the site where DNA is found in prokaryotic and eukaryotic cells.

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

d. Part of the base sequence on DNA that codes for normal adult haemoglobin is:

A C T C C T G A G G A G

- i) What type of molecule is haemoglobin? \_\_\_\_\_ (1)
- ii) Explain how the base sequence shown above codes for normal adult haemoglobin.

(2)

e. Part of a base sequence on DNA is:

A C T C C T G T G G A G

- i) State if this base sequence also codes for normal adult haemoglobin. \_\_\_\_\_ (1)
- ii) Explain your answer.

(2)

**(Total: 11 marks)**

3. A group of students investigated the effect of light intensity on the rate of photosynthesis in pondweed. The cuttings of the pondweed were exposed to different light intensities, each for one hour. Figure 3.1 shows the apparatus used in this investigation.

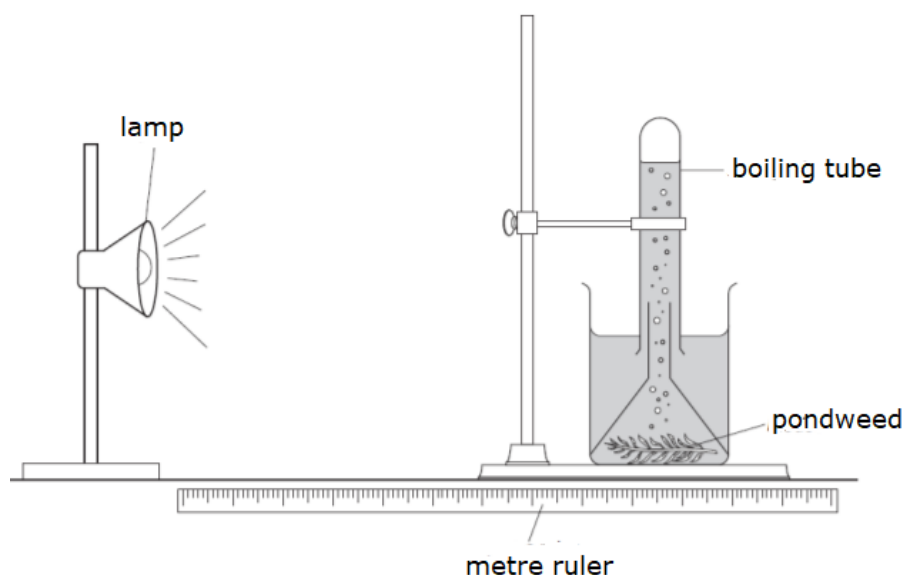


Figure 3.1: Apparatus setup to investigate the effect of light intensity on the rate of photosynthesis in pondweed  
(Source: <http://resource.download.wjec.co.uk.s3.amazonaws.com/>)

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

- a. i) The pondweed is in a dilute sodium hydrogen carbonate solution, which provides the plant with carbon dioxide. State why it is better to use the above-mentioned solution rather than water.

(1)

- ii) Name **ONE** variable that is kept constant to ensure that the results of the experiment were valid.

(1)

- b. The amount of oxygen gas produced was recorded and used to indicate the rate of photosynthesis. Table 3.1 shows the results obtained.

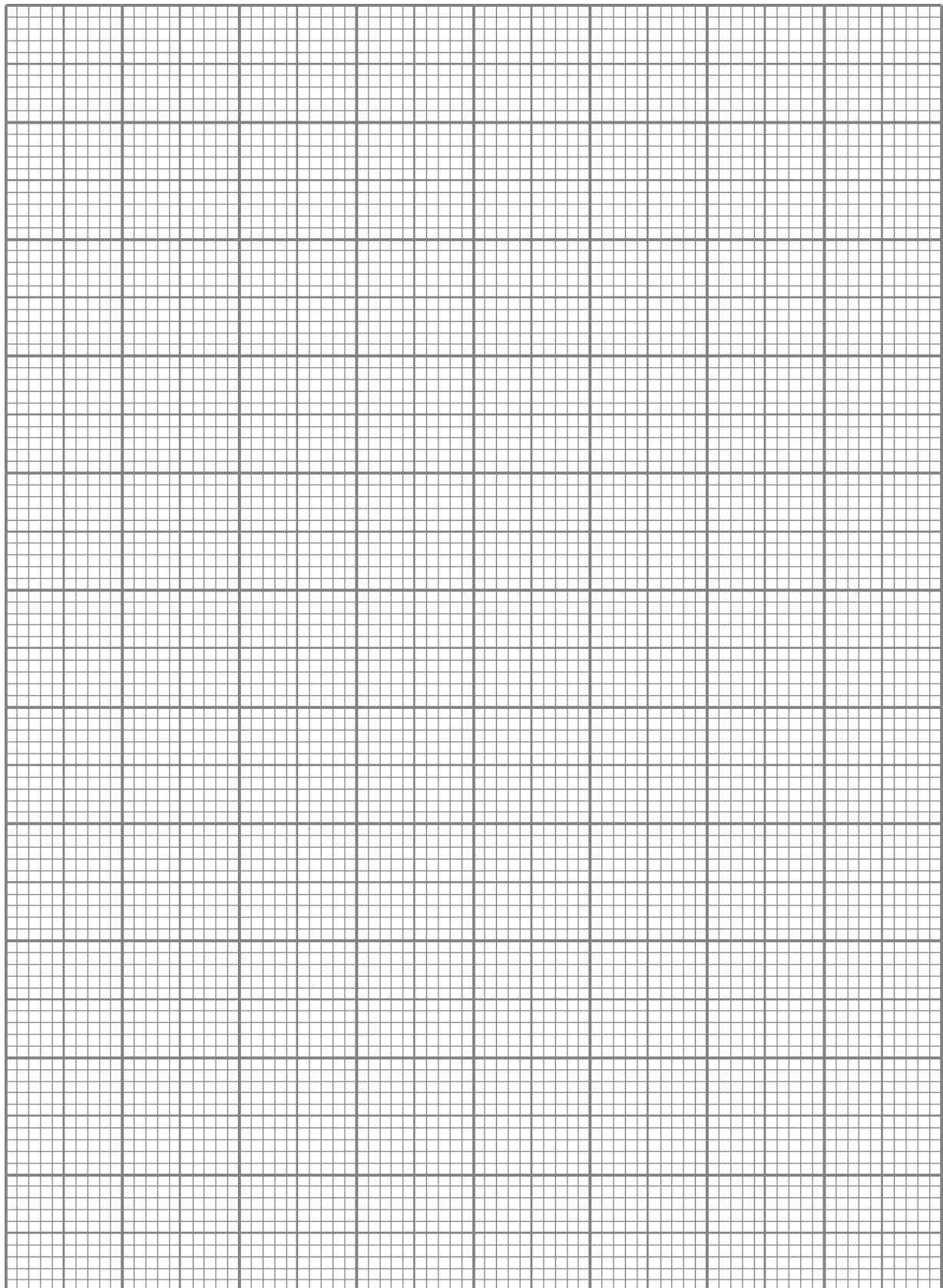
Table 3.1 Oxygen production ( $\mu\text{L}$ ) at different light intensities (arbitrary units)

| Light intensity (arbitrary units) | Oxygen production ( $\mu\text{L}$ ) |
|-----------------------------------|-------------------------------------|
| 0 (darkness)                      | 1                                   |
| 5                                 | 3                                   |
| 10                                | 5                                   |
| 15                                | No data                             |
| 20                                | 16                                  |
| 25                                | 25                                  |
| 30                                | 36                                  |
| 35                                | 40                                  |
| 40                                | 45                                  |
| 45                                | 46                                  |
| 50                                | 46                                  |
| 55                                | No data                             |

(Source: <https://senior-secondary.scsa.wa.edu.au/>)

- Using the graph paper, plot a graph of oxygen production ( $\mu\text{L}$ ) against light intensity (arbitrary units). Draw light intensity on the x-axis.

(4)



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

c. The students did not get data at light intensities of 15 and 55 arbitrary units (arb units). Use the graph to estimate the oxygen production at:

15 arb units \_\_\_\_\_ 55 arb units \_\_\_\_\_ (1, 1)

d. i) State whether you would expect the estimate for 15 arbitrary units or 55 arbitrary units to be more accurate.

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



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


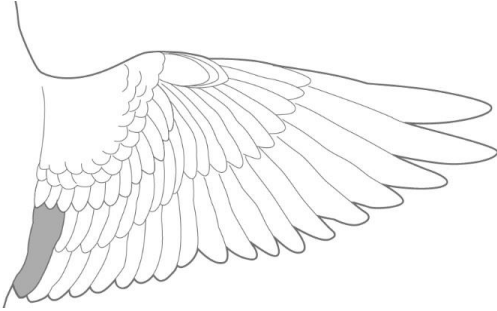

\_\_\_\_\_ (1)

**(Total: 10 marks)**

4. Living organisms may have appendages. These are structures that are attached to the body of the organism. Table 4.1 shows appendages that are characteristic of different animal groups. Using the information in the table, identify the phylum and class (if applicable) where these appendages are observed.

Table 4.1: Appendages in different animals

| Appendage  | Description of appendage                                     | Phylum | Class                   |
|--|--|--------|-------------------------|
|  <p>www.getcoloringpages.com</p>  | <p>Long jelly-like tentacle with stinging cells.</p>         |        | <p>(not applicable)</p> |
|  <p>www.biology-resources.com</p> | <p>One of six jointed legs, covered with an exoskeleton.</p> |        |                         |

| Appendage   | Description of appendage                           | Phylum | Class |
|---|--|--------|-------|
|  <p><a href="https://i.pinimg.com/originals">https://i.pinimg.com/originals</a></p>            | <p>Leg covered with moist skin without scales.</p> |        |       |
|  <p><a href="https://global.canon/en/environment">https://global.canon/en/environment</a></p> | <p>Wing covered in feathers.</p>                   |        |       |
|  <p><a href="https://www.sciencephoto.com">https://www.sciencephoto.com</a></p>              | <p>Leg covered with dry scaly skin.</p>            |        |       |

**(Total: 9 marks)**

***Please turn the page.***

5. a. Figure 5.1 shows a pyramid of numbers.

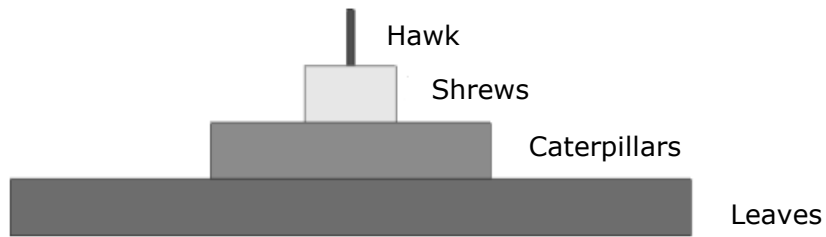


Figure 5.1: A pyramid of numbers  
(Source: <https://moodle.beverleyhigh.net/mod/resource/view.php?id=6139&forceview=1>)

Name the organisms that are secondary consumers and state the trophic level that they occupy.

Secondary consumers: \_\_\_\_\_ (1)

Trophic level: \_\_\_\_\_ (1)

b. Figure 5.2 shows an inverted pyramid of numbers.

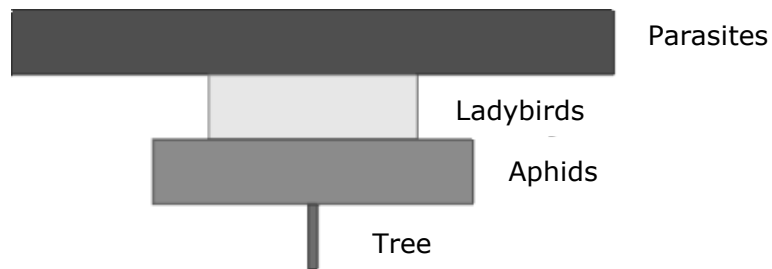


Figure 5.2: An inverted pyramid of numbers  
(Source: <https://moodle.beverleyhigh.net/mod/resource/view.php?id=6139&forceview=1>)

Identify **TWO** differences between the pyramid of numbers in Figure 5.2 and that in Figure 5.1.

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

c. Refer to the pyramid of numbers in Figure 5.2 and explain why:  
i) the number of ladybirds is smaller than the number of aphids;

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



ii) the number of parasites is larger than the number of ladybirds.

(2)

d. In the space provided sketch a pyramid of biomass of the feeding relationship shown in the pyramid of numbers in Figure 5.2.

(2)

**(Total: 10 marks)**

6. Body fluids help protect and cushion organs. Plant fluids help plants function normally. The table below lists several fluids found in living organisms and their functions. Match the fluid with its function by writing the correct letter in the space provided.

| Fluid               | Letter of function | Function  |
|---------------------|--------------------|---|
| Nectar              |                    | A. Protects the lining of the stomach from getting corroded by acid.                                      |
| Seminal fluid       |                    | B. Controls body temperature.   |
| Sweat               |                    | C. Attracts pollinators.  |
| Saliva              |                    | D. Neutralises hydrochloric acid and emulsifies fats.   |
| Xylem fluid         |                    | E. Transports sugar and amino acids.  |
| Mucus               |                    | F. Contains water and dissolved substances such as urea, ammonia, amino acids, glucose, and various ions. |
| Blood               |                    | G. Transports water and mineral salts.  |
| Glomerular filtrate |                    | H. Helps keep the sperm cells alive.  |
| Bile                |                    | I. Helps compact food into softened particles to allow easier swallowing.                                 |
| Phloem fluid        |                    | J. Transports oxygen, carbon dioxide and waste materials.   |

**(Total: 10 marks)**

***Please turn the page.***

7. The gas exchange (respiratory) organs in arachnids are called book lungs. Air enters the book lungs through openings called stigmata. The membrane lining the book lungs is the gas exchange surface. It is folded into numerous delicate lamellae, like the pages of a book. Figure 7.1 shows the book lungs in an arachnid.

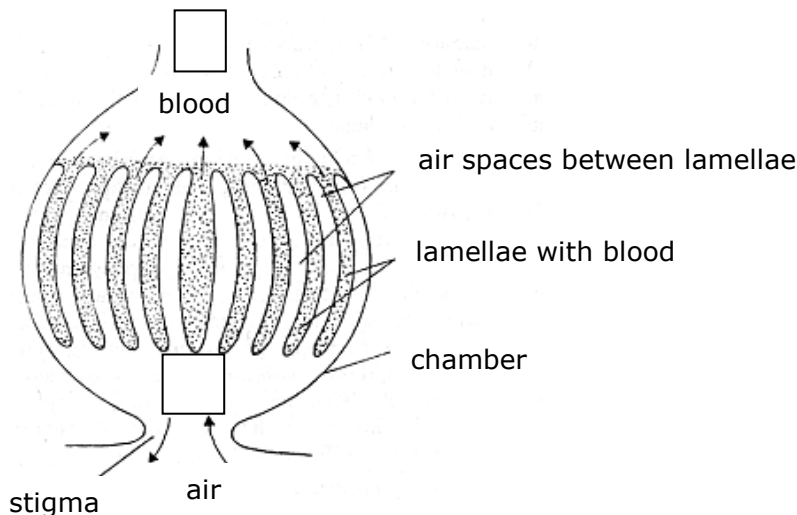


Figure 7.1: Book lungs in an arachnid  
 (Source: <http://www.expertsmind.com/questions/respiration-in-scorpion-or-spider>)

a. Explain how **each** of the following increases the rate of gas exchange in the book lung:

- i) the lining membrane of the book-lung is folded like the pages of a book;

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

- ii) the lamellae have a rich blood supply.

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

b. Apart from the characteristics mentioned in parts a(i) and a(ii) name **TWO** other characteristics of a gaseous exchange surface.

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

c. Fresh air is drawn into the chamber and **after** exchange of gases by diffusion in the lamellae, the air is expelled by muscular action. In the boxes in Figure 7.1, write:

- i) an A in the position of the highest oxygen concentration; (1)
- ii) a B in the position of the highest carbon dioxide concentration. (1)

d. Figure 7.2 shows part of the human gas exchange system. Label parts A, B, C and D. (2)

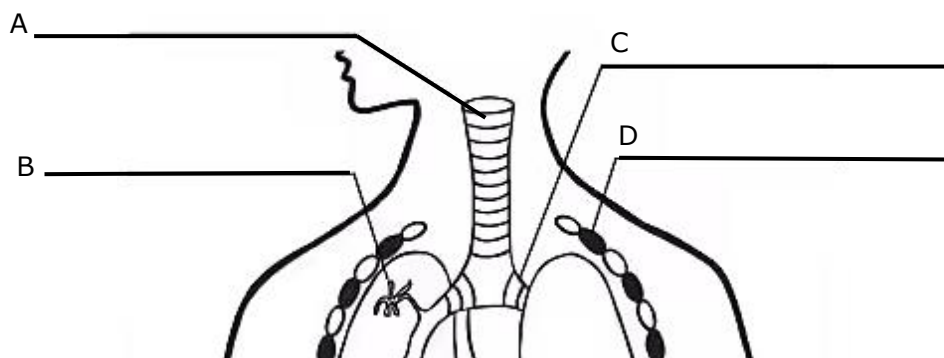


Figure 7.2: Part of the human gas exchange system

(Source: <http://www.twinkl.com/mt>)

**(Total: 10 marks)**

8. The COP-26 conference was held in Glasgow in November 2021. The main aim of the conference was to control pollution in the coming years. The countries participating in the COP-26 conference decided to reduce the yearly burning of coal (a fossil fuel) by 40% and to stop deforestation i.e., cutting down trees.

a. Name:

i) a gas containing carbon released when coal is burned: \_\_\_\_\_ (1)

ii) a gas that lacks carbon released when coal is burned: \_\_\_\_\_ (1)

b. Give **TWO** reasons how reducing the yearly burning of coal by 40% may control pollution.

Reason 1: \_\_\_\_\_

\_\_\_\_\_

Reason 2: \_\_\_\_\_

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

c. Explain how stopping deforestation will also help in reducing pollution in the coming years.

\_\_\_\_\_

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

d. Participating countries decided to stop paying part of the cost of coal to make it cheaper for the consumers. Explain how this should help to decrease pollution.

\_\_\_\_\_

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

**(Total: 10 marks)**

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9. a. For each question below, write a statement explaining the difference between each pair of terms.

i) Ingestion and digestion.

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(2)

ii) Assimilation and absorption.

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(2)

b. The mode of nutrition in an animal-like protist includes ingestion, absorption, and egestion. In the space provided, draw a set of **THREE** simple diagrams to show these processes in an animal-like protist. (3)

c. A student wrote, "Both humans and animal-like protists adopt heterotrophic nutrition." State if this statement is correct or not and give a reason for your answer.

Statement is: \_\_\_\_\_ (1)

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

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(2)

**(Total: 10 marks)**

10. The primrose plant has two types of insect-pollinated flowers as seen in Figure 10.1.

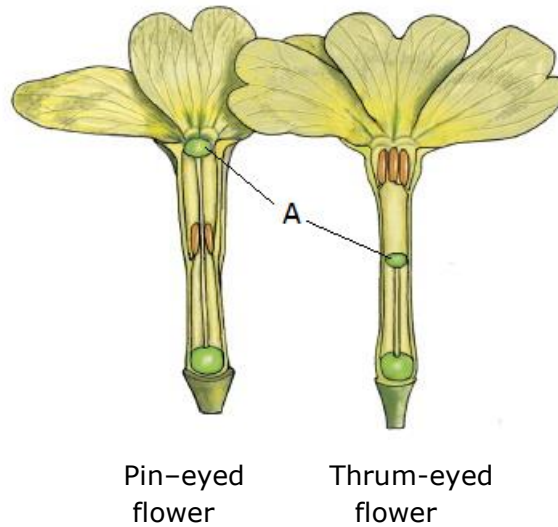


Figure 10.1: Two types of flowers produced by the primrose  
 (Source: <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/primula-vulgaris>)

a. i) Name structure A, on which pollen is deposited by bees.

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

ii) Fertilisation occurs in the ovary of the flower. Mark the region of the ovary on each flower with a letter B. (1)

iii) Describe how the male gamete travels from structure A to the ovary of the flower.

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

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

b. The genes responsible for pin-eyed and thrum-eyed primrose flowers are found on a part of the *Primula* genome called the S locus. The pin-eyed flower has a homozygous recessive genotype, while the thrum-eyed flower is heterozygous. Using the symbols **S** for the dominant allele and **s** for the recessive allele, determine the phenotypic ratio that will arise from a cross between a pin-eyed flower and a thrum-eyed flower.

Parental phenotypes:                      Pin-eyed flower                      x                      Thrum-eyed flower

Parental genotypes:                      \_\_\_\_\_ x                      \_\_\_\_\_

Gametes:



Genetic diagram/  
Punnett square

Phenotypic ratio of progeny                      \_\_\_\_\_                      \_\_\_\_\_ (4)

c. The presence of the two types of flowers in a population promotes cross-pollination. Distinguish between cross-pollination and self-pollination.

\_\_\_\_\_

\_\_\_\_\_

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

**(Total: 10 marks)**

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|               |                           |
|---------------|---------------------------|
| SUBJECT:      | <b>Biology</b>            |
| PAPER NUMBER: | IIA                       |
| DATE:         | 10 <sup>th</sup> May 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.

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.

**Turning fish waste into a valuable resource**

Consumption of fish is a wasteful business, especially where large fish species, notably bluefin tuna and swordfish, are involved. In fact, heads, tails, and fins, as well as the offal (entrails such as internal organs) of farmed bluefin tuna individuals are regularly discarded in open waters.

This apparent 'waste' conflicts with the idea of reusing resources. The disposal of tons of waste from bluefin tuna into the sea also affects the marine ecosystems.

The BYTHOS project, involving three Maltese partners (the University of Malta, the Department of Fisheries and Aquaculture and AquaBioTech), and three Sicilian partners, has shown the real value of such fish 'waste'.

Biologically Active Molecules (BAMs), notably collagen and fish oils, have been extracted from discarded bluefin tuna components within labs at the University of Malta by a research group led by Prof. Marion Zammit Mangion. Fish oils include several OMEGA-3 oils, which are marketed as popular nutritional supplements due to their beneficial action on heart health.

Collagen is a protein naturally found in the human body and is an essential component of tissue in skin, bones, and muscles. Collagen can enhance skin strength and elasticity, serving as an anti-wrinkle agent for skin. Collagen is applied in many skincare products. It is also added to beauty drinks aimed to enhance skin and nail quality.

The waste factor from fish-handling industries can be further minimised through the production of fish feed in pellet form for the aquaculture industry from the same waste, a milestone which has been achieved within the BYTHOS project by the AquaBioTech team.

It is now hoped that the results of the BYTHOS project will lead to a shift in the way we perceive discards from the fishing and aquaculture industry.

*(Adapted from: Deidun A., Turning fish waste into a valuable resource; in The Times of Malta 09/05/2021)*

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

- a. Bluefin tuna and swordfish are both bony fish.
  - i) Name the phylum and class to which these two organisms belong. (2)
  - ii) Give **ONE** characteristic feature that allows these organisms to be classified in this phylum. (1)
  - iii) Give **ONE** characteristic structural feature that allows these organisms to be classified in this class. (1)
- b. Explain **ONE** way how discarding fish 'waste' may positively affect a marine ecosystem. (2)
- c. Draw a labelled diagram showing a molecule of a typical fish oil. (2)
- d. i) Name an element that is found in collagen but is absent in fish oil. (1)
  - ii) Describe how a student may test for the presence of collagen in a beauty drink. (2)
- e. Explain why the presence of oils and proteins in the fish feed pellets is important. (2)

**(Total: 13 marks)**

2. The table below shows the changes which occur in a body's food stores during four weeks of food deprivation.

Table 2.1 Changes in the food stores in the human body

| Weeks of food deprivation | Mass of body food stores (kg) |       |          |
|---------------------------|-------------------------------|-------|----------|
|                           | Protein                       | Lipid | Glycogen |
| 0                         | 10.0                          | 10.0  | 2.1      |
| 1                         | 9.8                           | 8.0   | 0.4      |
| 2                         | 9.1                           | 6.0   | 0.1      |
| 3                         | 8.6                           | 4.0   | 0.0      |
| 4                         | 8.3                           | 2.2   | 0.0      |

- a. On the graph paper provided (use the 2mm grid scale), plot a graph to show how the masses of protein, lipid, and glycogen changes over four weeks of food deprivation. Join points with a ruler. Plot the number of weeks of food deprivation on the x-axis. (8)
- b. i) Explain why all cells in the body begin to break down protein after several days of food deprivation. (1)
  - ii) Two effects of food deprivation are the inability to control body temperature and the weakening of the immune system. What advantage does this have? (1)
- c. Draw **TWO** conclusions from the graph. (2)

**(Total: 12 marks)**

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

3. Paper pulp is derived from plant cells which contain cellulose in their cell walls.

An experiment is set up to demonstrate the effectiveness of cellulase in breaking down paper pulp. Cellulase requires at least a few hours to release sugars from the cellulose.

Four test tubes are prepared as follows:

| Test tube No: | Contents   |
|---------------|--|
| 1             | Paper pulp exposed to cellulase overnight.                         |
| 2             | Paper pulp exposed to cellulase during the experimental procedure. |
| 3             | Paper pulp exposed to alcohol.                                     |
| 4             | Paper pulp exposed to water.                                       |

10 drops of Benedict's reagent are added to each test tube and the solutions are swirled gently for a few minutes. The test tubes are suspended in a water bath at about 45 °C for an hour. The test tubes are removed from water bath and allowed to cool.

Benedict's test gives different coloured precipitates at different concentrations of reducing sugars as follows:

- Green precipitate at low concentrations of reducing sugar.
  - Orange precipitate at medium concentrations of reducing sugar.
  - Red precipitate at high concentrations of reducing sugar.
- a. i) Explain why the the contents of each test tubes are swirled gently when Benedict's reagent is added. (1)
- ii) Explain why the water bath was kept at 45 °C. (1)
- b. Test tubes 1 to 4, all have the same colour at the start of the experiment. State the colour observed. (1)
- c. i) Predict the colour expected in each of test tube 1 to 4 after heating. (4)
- ii) Explain the results predicted in part c (i). (8)
- d. Paper pulp is exposed to boiled catalase overnight. Predict the colour expected after heating with Benedict's solution. Give a reason for your answer. (2)
- e. i) Explain why humans cannot digest cellulose while ruminants can. (2)
- ii) Describe the process of cellulose digestion in ruminants. (4)
- iii) Name the type of relationship between ruminants and the microorganisms that live in their gut. (2)

**(Total 25 marks)**

***Please turn the page.***

4. A group of students carried out an experiment to investigate eutrophication. They labelled four jars, 1-4, lowered them 2 m below the water surface and filled the jars with 150 cm<sup>3</sup> of pond water. To each jar, they added different amounts of fertiliser. The students covered the jars with cheesecloth and left them a sunny location. They measured the amount of oxygen dissolved in water at the start of the experiment, after 7 days and after 14 days. Table 4.1 shows the results obtained.

Table 4.1: Results of an experiment on eutrophication

| Jar no. | Volume of Pondwater added / cm <sup>3</sup> | Amount of fertiliser added / g | Amount of Oxygen dissolved in water on day 0 (at the start) of the experiment / ppm | Amount of Oxygen dissolved in water after 7 days / ppm | Amount of Oxygen dissolved in water after 14 days / ppm |
|---------|---|--------------------------------|---|--|---|
| 1       | 150   | 0                              | 8   | 8  | 8   |
| 2       | 150   | 1                              | 8   | 6  | 4   |
| 3       | 150   | 2                              | 8   | 4  | 2   |
| 4       | 150   | 4                              | 8   | 2  | 0   |

(Adapted from <https://www.education.com/science-fair/article/eutrophication/>)

- a. Define the term eutrophication. (2)
- b. Give **ONE** reason for each of the following:
- the students filled the jars with pondwater rather than distilled water; (2)
  - jars 1 – 4 filled with the same volume of water from the same depth; (2)
  - all the jars were placed in a sunny location. (2)
- c. i) Identify the jar that acts as a control in the experiment. Give a reason for your answer. (2)
- ii) Explain why a control was included in this experiment. (2)
- d. Identify **ONE** source of error in this experiment. (2)
- e. i) Write a short discussion of the results obtained, explaining how this experiment shows the effect of eutrophication. (5)
- ii) Write a conclusion for this experiment. (2)

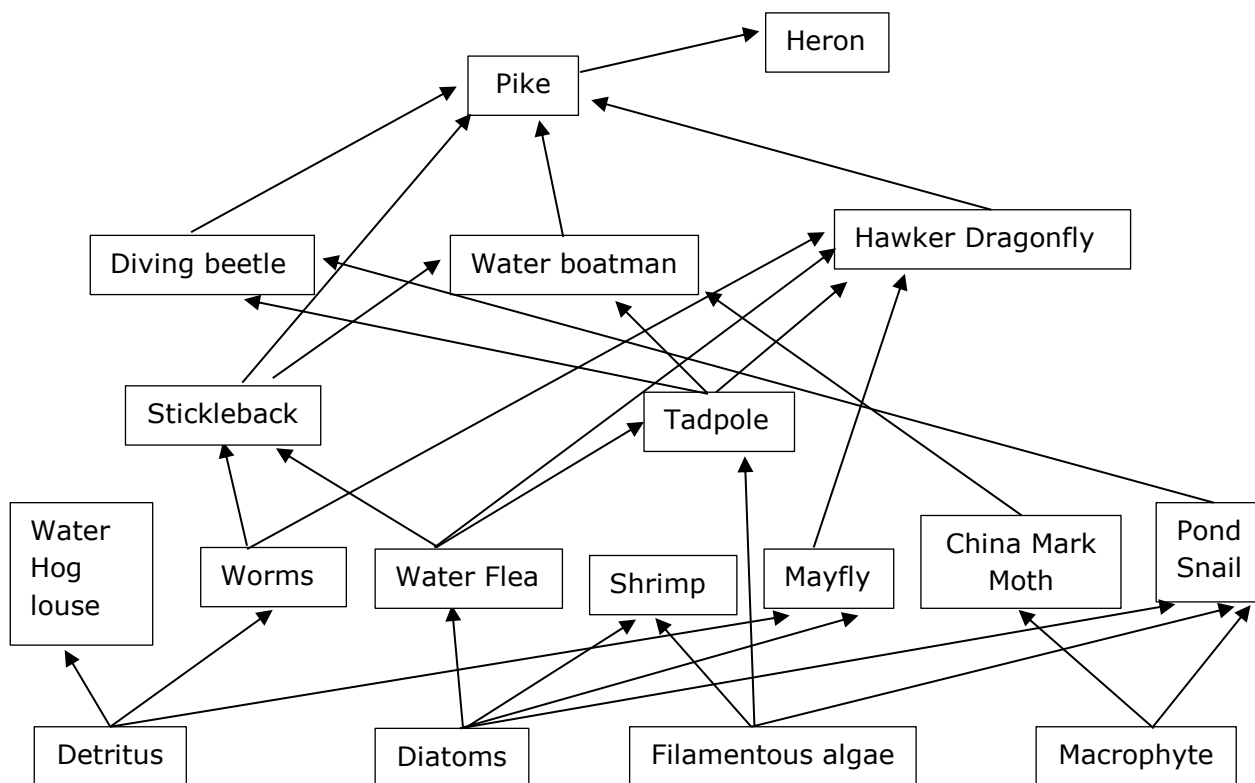


Figure 4.1: Generalised food web in a pond  
 (Source [www.lifeinfreshwater.org.uk/web%20pages/ponds](http://www.lifeinfreshwater.org.uk/web%20pages/ponds))

- f. Figure 4.1 shows a generalised food web in a pond. Use the diagram, and starting from **detritus**, draw a food chain showing:
- i) the heron at the fifth trophic level; (1)
  - ii) the heron at the sixth trophic level. (1)
- g. Explain why the number of animal species decreases on moving from the second to the fifth trophic level in the food web. (2)

**(Total: 25 marks)**

5. a. Animals and plants are adapted to survive in many environments, from hot deserts to cold polar regions. A camel is an example of an organism with desert adaptations. It can keep cool and use water efficiently. A polar bear is an example of an organism with arctic adaptations. It can reduce heat loss. Describe and explain **THREE** ways how:
- i) desert animals are adapted to their environment; (6)
  - ii) arctic animals are adapted to their environment. (6)
- b. Plants living in dry arid habitats are called xerophytes. List **THREE** structural features which xerophytes may show to reduce the amount of water loss from the aerial part of the plant. (3)

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

- c. The graph in Figure 5.1 below shows the fluctuations in the population of a predator species over many years.

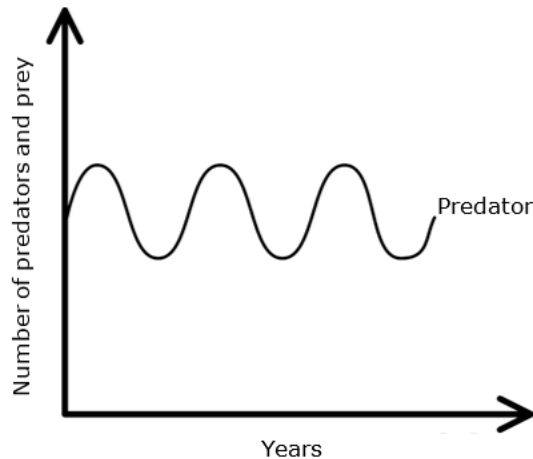


Figure 5.1: Graph showing fluctuations in a predator population

- i) Copy the graph into your answer book. Then, on the same axes and using a dotted line, show how the population of the predator's main prey species might vary over the same time span. (3)
- ii) Explain the graph that you have drawn for the prey species. (4)

- d. Farmers are encouraged to use biological pest control by introducing predators to feed on pests affecting their crops.

- i) Give **ONE** advantage of using this method to control pests. (2)
- ii) Besides the introduction of predators, there are other ways how to control pests biologically. State **ONE** of these. (1)

**(Total 25 marks)**

6. a. Parthenogenesis is a type of asexual reproduction where an unfertilised egg develops into an organism. Species of ants, bees and wasps use this asexual reproduction to produce haploid male members of their community.

- i) Ants, bees, and wasps are arthropods. State **ONE** characteristic feature of this phylum. (1)
- ii) Define the term haploid. (1)
- iii) The haploid male members produce identical sperm cells that are also haploid. Determine the type of cell division that cells that produce gametes in these male organisms, undergo. (1)
- iv) State **ONE** advantage of asexual reproduction and **ONE** disadvantage of asexual reproduction. (2)

- b. Humans have reproductive systems that allow sexual reproduction to occur. In females, the organs present, and the hormones produced in different quantities during the menstrual cycle, release an ovum at a specific time during the cycle.

- i) The hormone FSH (Follicle-Stimulating Hormone) stimulates the ovary. Describe **ONE** effect of the hormone on the ovary. (1)
- ii) The ovary secretes the hormone oestrogen. Name the target organ of this hormone and describe its effect. (2)
- iii) When should copulation occur for the released ovum to become fertilised? Explain your answer. (3)
- iv) Name the hormone that triggers ovulation. (1)

- c. Once the ovum is released, it will start moving towards the uterus.
- i) Name the organ into which the ovum is released and describe the structure of this organ. (3)
  - ii) Describe where and how internal fertilisation takes place in humans. (3)
- d. Once implantation occurs, the embryo and the placenta begin to develop. State the role of the corpus luteum during this period. (2)
- e. Explain the biological importance of the following:
- i) in a mature placenta, the length of capillaries is about 320kms. (3)
  - ii) sexual reproduction ensures that a species can adapt to a new environment. (2)

**(Total: 25 marks)**

7. Robert Whittaker (1969) classified organisms into five groups. Organisms were classified depending on certain general characteristics.
- a. Compare and contrast organisms from the protist and fungal kingdoms. In the comparison, write features of the two kingdoms including cell type (prokaryotic/eukaryotic), cell organisation (uni/multicellular), presence/absence of cell wall and nutritional type. (7)
  - b. The sea anemone is sometimes mistaken for a plant. However, it is an animal of the phylum cnidaria (coelenterates) found in seas and oceans.

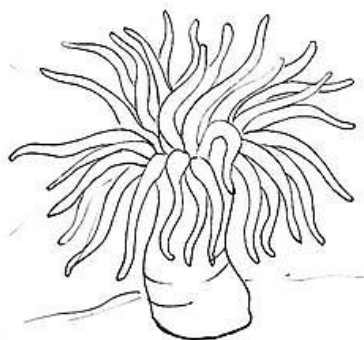


Figure 7.1: A sea anemone  
(Source: <https://www.pinterest.com/nemanjaimama/sea>)

- i) From Figure 7.1, list **ONE** feature that explains why it is mistaken for a plant. (1)
  - ii) The sea anemone builds a mutualistic relationship with the clownfish, which lives amongst its tentacles. Describe the role of the sea anemone and the clownfish in this relationship. (2)
- c. Manatees are born under water and the calves drink their mother's milk until they learn to graze on aquatic plants. They breathe in air at the sea surface but can remain submerged for about 15 minutes. Name the vertebrate class of this organism and from the text, give the characteristic that made you choose this class. (2)
- d. The first land plants to evolve were moss-like plants with no vascular tissue. Explain why these plants do not grow as large as plants that have vascular tissue. (2)

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

e. Ferns, gymnosperms, and angiosperms all contain vascular tissue. Figure 7.2 shows leaves from the three different phyla (divisions).

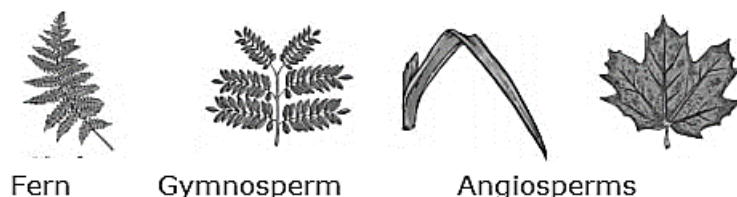


Figure 7.2: Leaves of vascular plants  
 (Source: <https://www.twinkl.com/mt/teaching-wiki/classification-of-plants>)

- i) Ferns have a waxy layer on their leaves. Describe the importance of this evolutionary feature. (2)
- ii) Describe how gymnosperms have evolved to conserve water. (1)
- iii) Gymnosperms and Angiosperms are both seed bearing plants. Distinguish between this feature in the two phyla. (2)
- iv) Figure 7.2 shows two leaves from different groups of angiosperms. Copy the table below and fill in the characteristics to distinguish between these two groups.

|                        | <b>Monocots</b> | <b>Dicots</b> |
|------------------------|-----------------|---------------|
| Type of root system    |                 |               |
| Vein feature in leaf   |                 |               |
| Number of floral parts |                 |               |

(3)

f. Viruses do not form part of the five groups organised by Whittaker.

- i) Give **ONE** reason why viruses are not part of the Whittaker classification system. (1)
- ii) Describe the general structure of a virus. (2)

**(Total: 25 marks)**






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|               |                           |
|---------------|---------------------------|
| SUBJECT:      | <b>Biology</b>            |
| PAPER NUMBER: | IIB                       |
| DATE:         | 10 <sup>th</sup> May 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.

Please note that for question 3 of this paper you need the graph paper in the booklet.

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

1. a. Consumption of fish generates a lot of waste, especially where large fish species like bluefin tuna and swordfish, are involved. In fact, heads, tails, and fins, as well as the offal (internal organs such as gills and intestines) of farmed bluefin tuna fish are regularly thrown away in the open sea.

Bluefin tuna and swordfish are both bony fish.

- i) Name the phylum and class to which these two organisms belong. (2)
- ii) Give **ONE** characteristic feature that allows these organisms to be classified in this phylum. (1)
- iii) Draw a simple **diagram** showing the main characteristic features of a bony fish. On the diagram label **THREE** characteristic features. (6)

- b. This apparent 'waste' conflicts with the idea of reusing resources. The throwing away of tons of waste from bluefin tuna into the sea also affects the marine ecosystems.

Explain **ONE** way how fish 'waste' may positively affect a marine ecosystem. (2)

- c. The BYTHOS project has shown the real value of such fish 'waste'. Several Biologically Active Molecules (BAMs), notably collagen and fish oils, have been extracted from discarded bluefin tuna components within labs at the University of Malta by a research group led by Prof. Marion Zammit Mangion.

Draw a labelled diagram showing a molecule of a typical fish oil. (3)

- d. Collagen is a protein naturally found in the human body and is an essential component of skin, bones, and muscles. It can enhance skin strength and elasticity, serving as an anti-wrinkle agent for skin. Collagen is also added to beauty drinks aimed to enhance skin and nail quality.

- i) List the **FOUR** elements found in collagen that are common to all proteins. (2)
- ii) Name the element that is found in collagen but is absent in fish oil. (1)
- iii) Describe how a student may test for the presence of collagen in a beauty drink. (2)

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

- e. The waste factor from fish-handling industries can be reduced further by producing fish feed pellets to feed the fish grown in fish farms.

*(Adapted from: Deidun A., Turning fish waste into a valuable resource; in The Times of Malta 09/05/2021)*

Explain why it is important to include the following in fish feed pellets:

- i) protein; (2)
- ii) oil. (2)

- f. A scientist suggested that the fish food pellets must also include carbohydrates. Give a reason for this. (2)

**(Total: 25 marks)**

2. a. Parthenogenesis is a type of asexual reproduction where an unfertilised egg develops into an organism. Species of ants, bees and wasps use this asexual reproduction to produce haploid male members of their community.

- i) Ants, bees, and wasps are arthropods. State **TWO** characteristic features of this phylum. (2)
- ii) Define the term haploid. (1)
- iii) State whether it is the male or female of the species that undergoes parthenogenesis. From the text, give **ONE** reason for your answer. (2)
- iv) State **ONE** advantage of asexual reproduction and **ONE** disadvantage of asexual reproduction. (2)

- b. Humans have reproductive systems that allow sexual reproduction to occur. In females, the organs present, and the hormones produced in different quantities during the menstrual cycle, liberates an ovum at a specific time during the cycle.

- i) Write the main advantage of sexual reproduction. (1)
- ii) Draw a labelled diagram of the female reproductive system. (4)
- iii) The hormone FSH (Follicle-Stimulating Hormone) stimulates the ovary. Describe **ONE** effect of the hormone on the ovary. (1)
- iv) The ovary secretes the hormone oestrogen. Name the target organ of this hormone and describe its effect. (2)
- v) When should copulation occur for the released ovum to become fertilised? Explain your answer. (3)

- c. Once the ovum is released, it will start moving towards the uterus through the fallopian tube/oviduct.

- i) Name the organ where internal fertilisation takes place. (1)
- ii) Define fertilisation. (2)

- d. The corpus luteum produces the hormone progesterone. State the function of this hormone and explain why it is important in pregnancy. (3)

- e. The mother's milk is considered important in the development of the new-born baby. State **ONE** reason for this statement. (1)

**(Total: 25 marks)**

3. Table 3.1 below shows the changes which occur in the food stores in the human body during four weeks of food deprivation.

Table 3.1 Changes in the food stores in the human body

| Weeks of food deprivation | Mass of food stores (kg) |       |          |
|---------------------------|--------------------------|-------|----------|
|                           | Protein                  | Lipid | Glycogen |
| 0                         | 10.0                     | 10.0  | 2.1      |
| 1                         | 9.8                      | 8.0   | 0.4      |
| 2                         | 9.1                      | 6.0   | 0.1      |
| 3                         | 8.6                      | 4.0   | 0.0      |
| 4                         | 8.3                      | 2.2   | 0.0      |

- a. On the graph paper provided (use the 2mm grid scale), plot a graph to show the decrease in the mass of glycogen stored (kg) against weeks of food deprivation. Join the points of the graph with straight lines. Plot weeks of food deprivation on the x-axis. (Do **not** plot other data on the graph.) (6)
- b. Use the data in Table 3.1 to:
  - i) state what happens to the mass of protein, lipid, and glycogen after 4 weeks of food deprivation; (2)
  - ii) explain why the body only gains energy from lipid and protein between weeks 2 and 4 of food deprivation; (2)
  - iii) show that protein is the last type of food store that is broken down during a long period of food deprivation. (1)
- c. List **THREE** differences between carbohydrates and lipids. Present your answer in table format. (6)
- d. Proteins in food are digested into amino acids in the different parts of the alimentary canal. Copy the table and describe the process of digestion of proteins in each part of the alimentary canal listed. (8)

| Part of alimentary canal | Process of digestion of proteins |
|--------------------------|----------------------------------|
| Mouth                    |                                  |
| Stomach                  |                                  |
| Duodenum                 |                                  |
| Ileum                    |                                  |

**(Total: 25 marks)**

- 4. The following statements are incorrect. Write the correct statement and give biological reasons as to why the statement is incorrect.
  - a. In tropisms, a positive response is away from the stimulus. (4)
  - b. Wilting in plants occurs when water absorption is higher than transpiration. (5)

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

- c. Scientific names of living organisms include two names: the phylum followed by the genus name. (4)
- d. In recycling it is better to borrow certain items than buying them. (4)
- e. Oxygenated blood flows into the left atrium via the vena cava. (4)
- f. In lactic acid fermentation, oxygen is used, and carbon dioxide is produced. (4)

**(Total: 25 marks)**

5. A group of students carried out an experiment to investigate eutrophication. They labelled four jars, 1-4, lowered them 2 m below the water surface and filled the jars with 150 cm<sup>3</sup> of pond water. They added different amounts of fertiliser to each jar. The students covered the jars with cheesecloth and left them a sunny location. They measured the amount of oxygen dissolved in water after 7 days and after 14 days. Table 5.1 shows the results obtained.

Table 5.1: Results of an experiment on eutrophication

| Jar no. | Volume of Pondwater added / cm <sup>3</sup> | Amount of fertiliser added / g | Amount of Oxygen dissolved in water on day 0 (at the start) of the experiment / ppm | Amount of Oxygen dissolved in water after 7 days / ppm | Amount of Oxygen dissolved in water after 14 days / ppm |
|---------|---|--------------------------------|---|--|---|
| 1       | 150   | 0                              | 8   | 8  | 8   |
| 2       | 150   | 1                              | 8   | 6  | 4   |
| 3       | 150   | 2                              | 8   | 4  | 2   |
| 4       | 150   | 4                              | 8   | 2  | 0   |

*(Adapted from <https://www.education.com/science-fair/article/eutrophication>)*

- a. Describe the process of eutrophication. (5)
- b. Give **ONE** reason for each of the following:
  - i) the students filled the jars with pondwater rather than distilled water; (2)
  - ii) jars 1 – 4 were filled with the same volume of water from the same depth; (2)
  - iii) all the jars were placed in a sunny location. (2)
- c. Jar 1 is the control in the experiment. Explain why a control was included in this experiment. (2)
- d. Using the data in the table of results, describe the effect of increasing amount of fertiliser on the amount of oxygen dissolved in water. (3)
- e. Write a conclusion for this experiment. (2)

f.

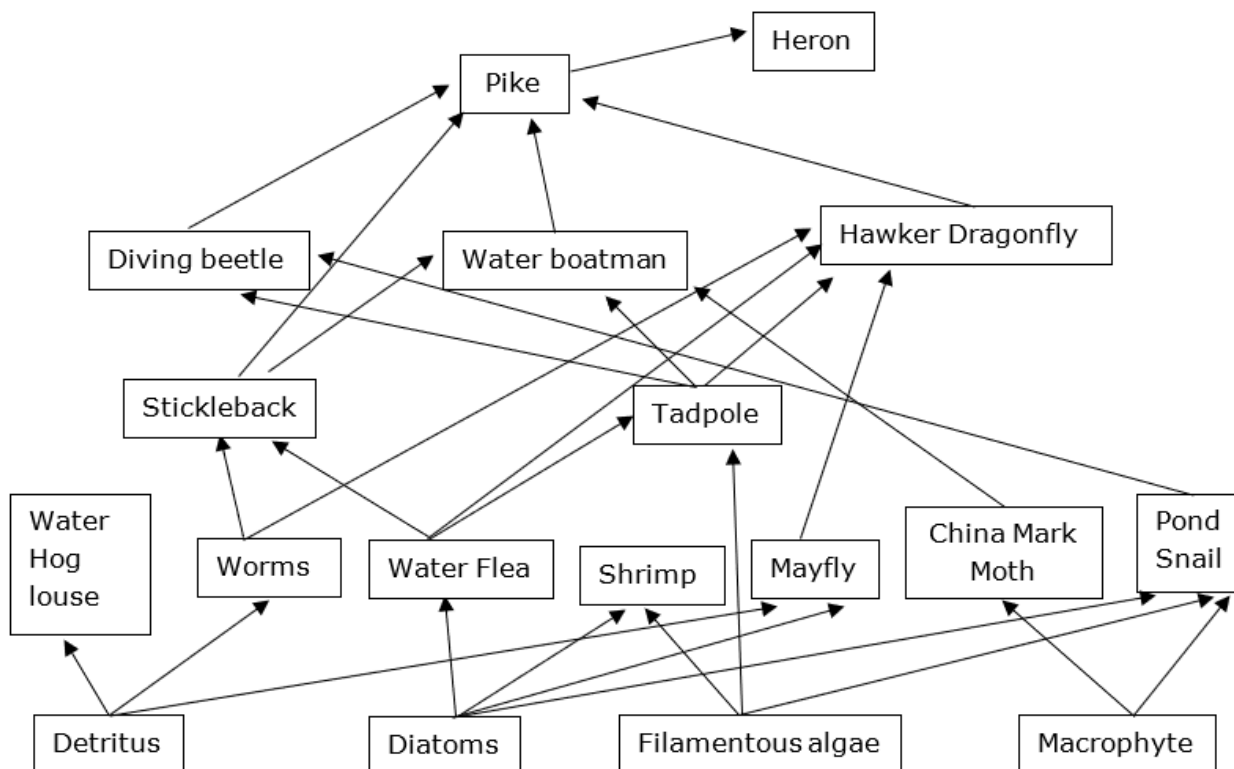


Figure 5.1: Generalised food web in a pond  
 (Source [www.lifeinfreshwater.org.uk/web%20pages/ponds/Predation%20Comms.htm](http://www.lifeinfreshwater.org.uk/web%20pages/ponds/Predation%20Comms.htm))

Figure 5.1 shows a generalised food web in a pond. Use the diagram, and starting from **detritus**, draw a food chain showing:

- i) the heron at the fifth trophic level; (1)
- ii) the heron at the sixth trophic level. (1)

- g. i) A student wrote: 'Macrophytes and diatoms are examples of producers in the pond water ecosystem'. Indicate if this statement is true or false. Give a reason for your answer. (2)
- ii) From the food web, identify the herbivore that is not eaten by any carnivore. (1)

h. Explain why the number of animal species decreases on moving from the second to the fifth trophic level in the food web. (2)

**(Total: 25 marks)**

6. Paper pulp is derived from plant cells which contain cellulose in their cell walls.

An experiment is set up to demonstrate the effectiveness of cellulase in breaking down paper pulp. Cellulase requires at least a few hours to release sugars from the cellulose. Four test tubes are prepared as follows:

| Test tube No: | Contents   |
|---------------|--|
| 1             | Paper pulp exposed to cellulase overnight.                         |
| 2             | Paper pulp exposed to cellulase during the experimental procedure. |
| 3             | Paper pulp exposed to alcohol.                                     |
| 4             | Paper pulp exposed to water.                                       |

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

10 drops of Benedict's reagent are added to each test tube and the solutions are gently swirled for a few minutes. The test tubes are suspended in a water bath at about 45 °C for an hour. The test tubes are removed from the water bath and allowed to cool.

Benedict's test gives different coloured precipitates at different concentrations of reducing sugars as follows:

- Green precipitate at low concentrations of reducing sugar.
- Orange precipitate at medium concentrations of reducing sugar.
- Red precipitate at high concentrations of reducing sugar.

- a. i) On adding the Benedict's reagent, why are the solutions swirled gently? (1)  
 ii) Explain why the water bath was kept at 45 °C. (1)
- b. Test tubes 1 to 4, all have the same colour at the start of the experiment. State the colour observed. (1)
- c. i) Predict the colour expected in each of test tubes 1 to 4 after heating. (4)  
 ii) Explain the results predicted in part c (i). (8)
- d. Paper pulp is exposed to boiled catalase overnight. Predict the colour expected after heating with Benedict's solution. Give a reason for your answer. (2)
- e. Ruminants are mammals such as sheep and cows that chew the cud.
  - i) Explain why humans are unable to digest cellulose but ruminants do. (2)
  - ii) Explain why the molars of sheep and cows are broad and have ridges. (2)
  - iii) Describe the process of cellulose digestion in ruminants. (4)

**(Total 25 marks)**

7. a. Animals and plants survive in many environments, from hot deserts to cold polar regions. They can do this because they are adapted to their environment. A camel is an example of an animal adapted to live in the desert as it can keep cool and use water efficiently. A polar bear is an example of an animal adapted to live in the arctic as it can reduce heat loss. Describe and explain **TWO** ways how:
  - i) desert animals are adapted to their environment; (4)
  - ii) arctic animals are adapted to their environment. (4)
- b. Plants living in dry arid habitats are called xerophytes. List **THREE** structural features which xerophytes may show to reduce the amount of water loss from the leaves of the plant. (3)
- c. i) Give **TWO** examples of a factor, other than light, which may be a source of competition among plants. (2)  
 ii) Give **TWO** examples, other than food, which may be a source of competition among animals. (2)

- d. The graph in Figure 7.1 below shows the fluctuations in the population of a predator species over many years.

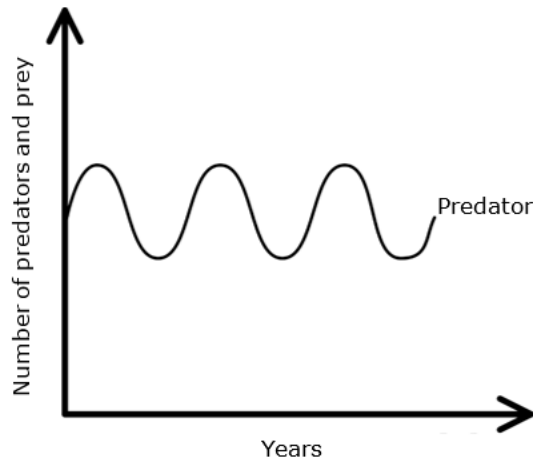


Figure 7.1: Graph showing fluctuations in a predator population

- i) Copy the graph into your answer book. Then, on the same axes and using a dotted line, show how the population of the predator's main prey species might vary over the same time span. (3)
  - ii) Explain the graph that you have drawn for the prey species. (4)
- e. i) Describe the role of predators in biological pest control. (1)
- ii) Give **ONE** advantage of using biological pest control. (2)
- (Total 25 marks)**
8. Robert Whittaker (1969) classified organisms into five groups. Organisms were classified depending on certain general characteristics of the organisms.
- a. Organisms of the protist and fungi kingdoms have some common characteristics and others that are different. Protists are mainly unicellular organisms, but the fungi kingdom has both unicellular and multicellular organisms.
    - i) Organisms of the two kingdoms mentioned above are eukaryotic. Define the term eukaryotic. (1)
    - ii) Give an example of a unicellular animal-like protist and an example of a unicellular fungus. (2)
    - iii) Draw a labelled diagram of a multicellular fungus such as a pin mould. (4)
    - iv) Animal-like protists have a heterotrophic mode of nutrition while plant like protists have an autotrophic mode of nutrition. Distinguish between heterotrophic and autotrophic modes of nutrition. (2)

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

b. Figure 8.1 shows a sea anemone, an animal which lives marine habitats.

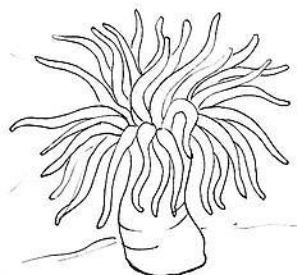


Figure 8.1: A sea anemone  
(Source: <https://www.pinterest.com/nemanjaimama/sea>)

The sea anemone builds a mutualistic relationship with the clownfish, which lives amongst its tentacles. Describe the role of the sea anemone and the clownfish in this relationship. (2)

c. Manatees are born under water and the calves drink their mother’s milk until they learn to graze on aquatic plants. Name the vertebrate class of this organism and from the text, give the characteristic that made you choose this class. (2)

d. The first land plants appeared about 470 million years ago. These were moss-like plants with no vascular tissue. Explain why these plants do not grow as large as plants that have vascular tissue. (2)

e. Ferns, gymnosperms, and angiosperms all contain vascular tissue. Figure 8.2 shows leaves from the three different phyla (divisions).

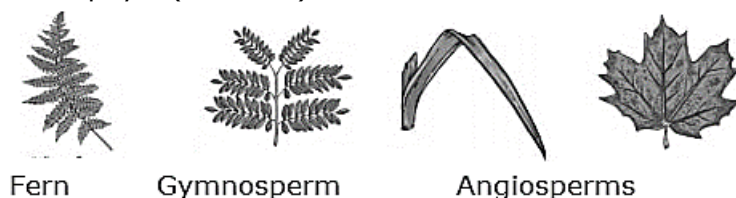


Figure 8.2: Leaves of vascular plants  
(Source: <https://www.twinkl.com/mt/teaching-wiki/classification-of-plants>)

- i) Apart from having vascular tissue, give **ONE** characteristic of ferns. (1)
- ii) Most gymnosperms have evolved needle-like leaves. These allow them to survive in cold temperatures when water is frozen. Describe the importance of this evolutionary feature. (2)
- iii) Gymnosperms and Angiosperms are both seed-bearing plants. Distinguish between this feature in the two phyla (divisions). (2)
- iv) Figure 8.2 shows two leaves from different groups of angiosperms. Copy the table below and fill in the characteristics to distinguish between these two groups.

|                               | Monocots | Dicots |
|-------------------------------|----------|--------|
| Vein feature in leaf          |          |        |
| Number of floral parts        |          |        |
| Number of cotyledons in seed. |          |        |

f. Describe the general structure of a virus. (2)

**(Total: 25 marks)**