



SUBJECT: **Biology**  
 PAPER NUMBER: I  
 DATE: 29<sup>th</sup> August 2022  
 TIME: 9:00 a.m. to 12:05 p.m.

### 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 in this booklet.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at **each** stage.
- The use of electronic calculators is permitted.

### For examiners' use only:

Question	1	2	3	4	5	6	7	8	9	Total
Score										
Maximum	10	12	14	10	10	15	9	10	10	<b>100</b>

1. This question is about cellular components.

- a. The table below shows some features that may or may not be present in different cells. Complete Table 1 with a tick (✓) if the feature is present or a cross (×) if the feature is absent.

Table 1: Showing presence or absence of cellular structures in different types of cells.

Feature	Cell			
	Bacterium	Erythrocytes	Palisade mesophyll cell	Squamous epithelial cell
Cell wall				
Nucleus				
Plasmid				

(4)

- b. Pancreatic cells produce large amounts of digestive enzymes and hormones. These cells contain many ribosomes and many mitochondria. Explain why these cells contain:

i. many ribosomes;

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

ii. many mitochondria.

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

- c. Provide a possible explanation for the following observations:

i. Not all plant cells contain chloroplasts.

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

ii. Plant cells generally need large, permanent vacuoles.

\_\_\_\_\_

\_\_\_\_\_

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

**(Total: 10 marks)**

2. This question is about transpiration rates.

Table 2 below shows the rates of transpiration of a house plant when exposed to different conditions of light, temperature and wind. In this experiment the rate of transpiration was measured as the mean distance moved by the bubble in the capillary tube of a potometer per minute.

Table 2: Showing the rates of transpiration of a houseplant when exposed to different environmental conditions.  
*(Adapted from: <https://connect.collins.co.uk/>)*

Experiment	Conditions	Rate of water uptake (cm/min)
A	Light, warm and no wind	6.3
B	Dark, warm and no wind	3.1
C	Light, warm and windy	11.6
D	Light, cold and no wind	4.2
E	Dark, cold and no wind	0.4

a. From the results obtained, determine which environmental condition influences transpiration rate the most. Use evidence from Table 2 to support your answer.

\_\_\_\_\_

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

b. Briefly explain the reason why the environmental condition mentioned in part (a). influences the transpiration rate.

\_\_\_\_\_

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

c. From the results obtained, determine which environmental factor influences transpiration rate the least. Use evidence from Table 2 to support your answer.

\_\_\_\_\_

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

**Question continues on next page.**

d. In separate experiments on the rate of transpiration, a scientist noted the following observations. For each statement, provide an explanation for its occurrence.

i. On changing from a high light intensity to a higher light intensity, the transpiration rate did not change.

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

ii. The rate of water uptake was not the same as the transpiration rate.

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

iii. In areas where leaves occur in clusters, the stomata remained open even when the water supply became limited.

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

**(Total: 12 marks)**

3. This question is about human reproduction.

Figure 1 is showing the levels of progesterone and oestrogen during pregnancy and after parturition.

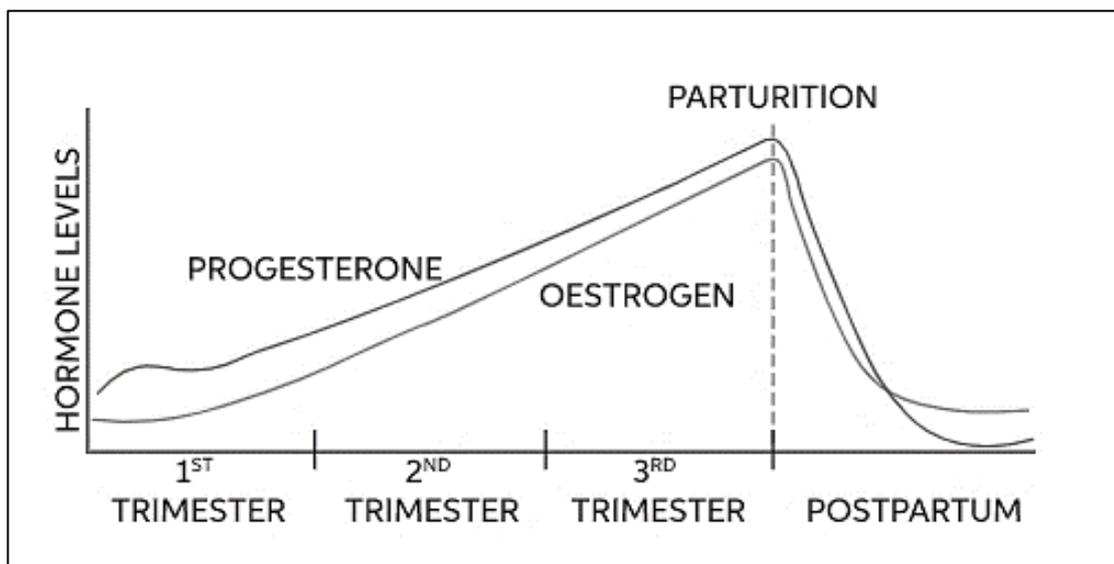


Figure 1: Oestrogen and progesterone levels during pregnancy and after parturition.  
(Obtained from: [https:// www.chegg.com/learn](https://www.chegg.com/learn))

a. Explain **TWO** roles for each of the hormones mentioned in Figure 1 during pregnancy.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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

b. The onset of labour is marked by an increased secretion of a particular hormone by the posterior pituitary gland. Identify the hormone and explain its function during labour.

\_\_\_\_\_

\_\_\_\_\_

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

c. Describe the **THREE** stages of parturition in the correct order.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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

d. i. Complete the following table by identifying whether the statement is TRUE or FALSE.

Table 3: A list of statements associated with human reproduction.

Statement	True or False
Fertilisation is the fusion of the sperm nucleus with the egg nucleus to form a diploid cell known as the zygote.	
As the zygote passes down the oviduct it divides by successive nuclear and cell divisions into a small ball of cells by a process called capacitation.	
Cleavage involves cell division without growth in size, because the cells continue to be retained within the zona pellucida.	

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

The chorion, along with tissues of the uterine wall, produces the lungs and act as the organ for nutrient, respiratory gas and metabolic waste exchange between the mother and the embryo.	
The foetal part of the placenta consists of cells of the chorion which produces projections called chorionic villi.	
The first secretion of the breast, following childbirth, is not milk but colostrum, and is believed to pass on antibodies from mother to offspring.	

(3)

ii. Choose a false statement from Table 3, and briefly explain why the statement was marked as false.

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

**(Total: 14 marks)**

4. This question is about gene amplification and identification techniques.

Polymerase chain reaction (PCR) has become an important tool especially in virulent gene testing. It is a multiple step process whereby each stage contributes to the amplification of the gene being tested.

a. Explain the importance of the following steps during PCR.

i. Temperatures are raised to around 95 °C during the initial stages.

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

ii. DNA primers are added to the mixture.

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

iii. Taq DNA polymerase is essential for the extension stage.

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

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b. Apart from PCR procedures, Southern blotting has also been an important tool for gene identification.

i. Which technique needs to be done prior to conducting Southern blotting?

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

ii. Name **ONE** reagent that is used in Southern blotting to denature the gene samples.

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

iii. Briefly explain why probes are used during Southern blotting.

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

**(Total: 10 marks)**

5. This question is about genetic inheritance.

Genes interact with one another to bring about variations in phenotypes. This all depends on the allele expression, where one may dominate over another.

a. Distinguish between the following terms:

i. Codominance and incomplete dominance.

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

ii. Polygenic inheritance and epistasis.

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

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

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b. Genetic conditions are considered to be inheritable. Those affected by the disease are termed as affected whilst those that do not show any symptoms of such, are termed as unaffected. Such inheritance may be autosomal or sex-linked, depending on the location of the gene.

i. Define the term autosomal.

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

ii. State whether the following occurrences are caused due to dominant or recessive alleles to the conditions under study.

Table 4: A list of statements related to inheritance.

Occurrence	Dominant or Recessive alleles that cause the condition
Two affected parents produce unaffected offspring.	
Two unaffected parents produce an affected offspring.	
Sex-linked affected parents produce females that are all affected, and males may/may not be affected.	
Sex-linked affected father mates with an unaffected mother to produce females and males that may/may not be affected.	

(2)

iii. Haemophilia is a sex-linked recessive trait. In the space below complete the probability of an F1 generation to show a cross between a female who is a carrier for haemophilia with a male with a normal blood clotting.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

iv. From your answers in part b. iii., state the fraction of:

male children who will have haemophilia; \_\_\_\_\_ (0.5)

female children who will have haemophilia; \_\_\_\_\_ (0.5)

**(Total: 10 marks)**

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6. This question is about evolution.

a. Read the following statements concerning evolutionary change and state whether you consider them to be correct or not. Give reasons for you answers.

i. Bacteria developing a resistance to antibiotics over a period of a few years may be described as an evolutionary change.

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(3)

ii. The existence of pesticide-resistant agricultural pests is an example of an evolutionary change.

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(3)

iii. Humans living in developed countries are generally taller than their recent ancestors because of a better diet and medicine. This may be described as an evolutionary change.

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(2)

iv. Evolutionary change only proceed through natural selection (survival of the fittest).

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(2)

***Question continues on next page.***

b. Speciation is the process by which one or more species arise from previously existing species. Speciation can be allopatric or sympatric. Distinguish between allopatric and sympatric speciation, substantiating your answer with examples.

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(4)

c. Give **ONE** example of a pre-zygotic isolation mechanism and **ONE** example of a post-zygotic isolation mechanism.

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(1)

**(Total: 15 marks)**

7. This question is about transport of respiratory gases.

Figure 2 shows a human adult oxygen dissociation curve for haemoglobin.

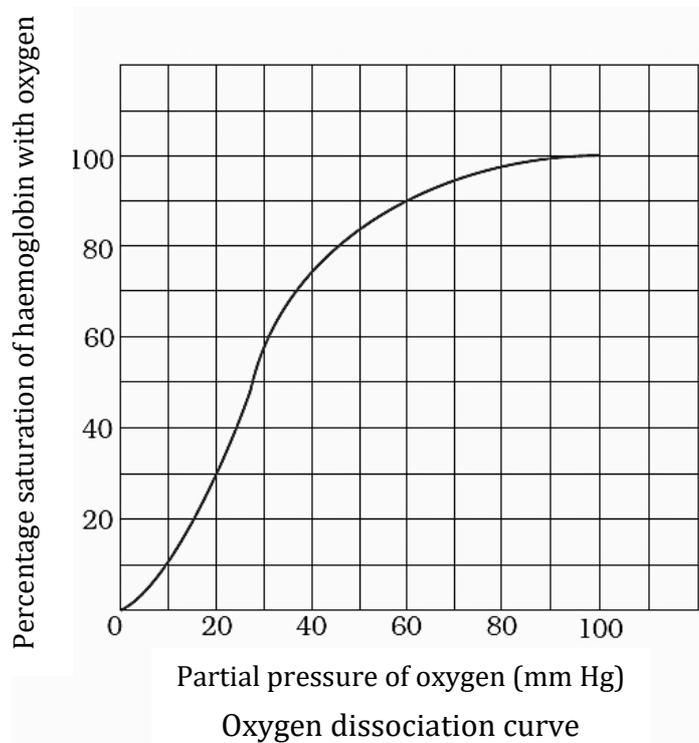


Figure 2: Human oxygen dissociation curve for haemoglobin.  
(Obtained from: <https://byjus.com/neet-questions/why-is-the-oxygen-dissociation-curve-s-shape>)

DO NOT WRITE ABOVE THIS LINE

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a. Suggest where in the body an oxygen partial pressure of 100 mmHg would be found.

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

b. On the graph in Figure 2, sketch the oxygen dissociation curve for human foetal haemoglobin. (2)

c. Explain the biological significance of the different oxygen dissociation curves of adult and foetal haemoglobin.

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

d. By the age of 6 months, the foetal haemoglobin in babies' blood has completely disappeared and replaced by adult haemoglobin. Use Figure 2 to explain the advantage of such change.

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

**(Total: 9 marks)**

***Question continues on next page.***

8. This question is about environmental biology.

Surtsey Island is a volcanic island lying 33 km off the southern coast of Iceland. The island was formed over four years between 1963 and 1967 when a submarine volcano 130 m below the ocean surface built up on an island that initially reached 174 m above sea level. The colonisation of the island by plants and animals has been recorded since the island's formation. Figure 3 shows the number of vascular plants over the years and Figure 4 shows different seed dispersal mechanisms for the vascular plants.

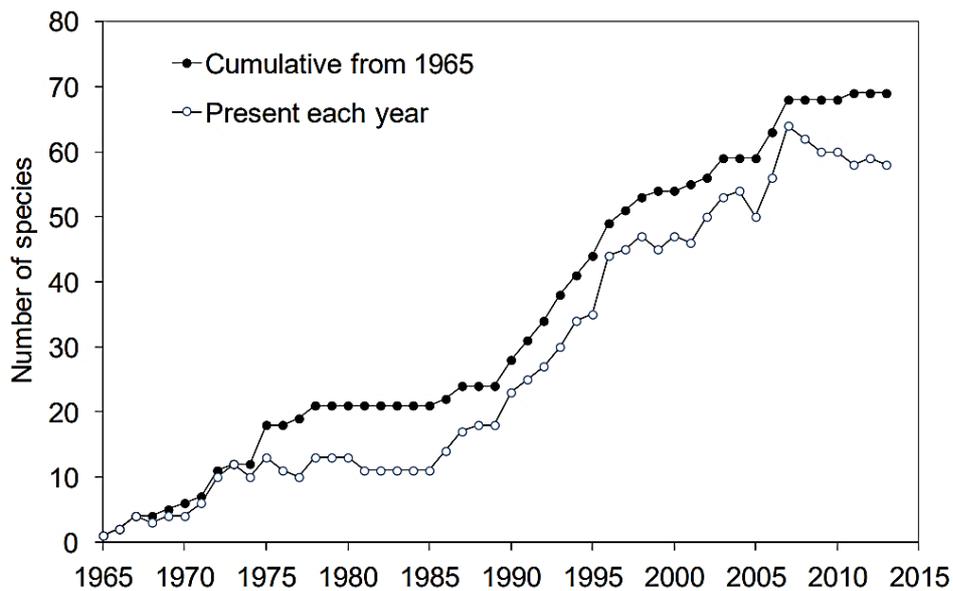


Figure 3: Number of vascular plant species found on Surtsey Island. (Obtained from: <https://www.researchgate.net>)

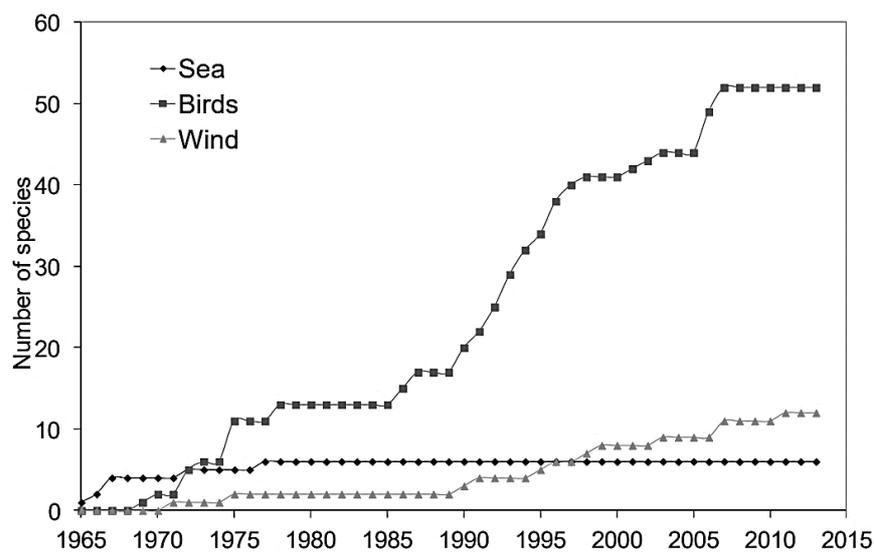


Figure 4: Cumulative dispersal routes of vascular plants to Surtsey Island. (Obtained from: <https://www.researchgate.net>)

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a. Distinguish between primary and secondary succession.

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(2)

b. Identify **ONE** example of early coloniser during the establishment phase of a community on bare rock.

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(1)

c. Describe **TWO** important roles of the species that are early colonisers of bare rock.

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(2)

d. Explain why climax communities are more stable and resistant to disturbance than early successional communities.

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(2)

e. Explain why secondary succession tends to be more rapid than primary succession.

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(1)

**Questions continue on next page.**

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f. Use both graphs in Figure 3 and 4 to identify the year of arrival of the second wave of plant colonisers. Suggest a reason for this second wave of colonisers.

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(2)

**(Total: 10 marks)**

9. This question is about biomolecules.

a. Proteins are made up of long chains of amino acids. Draw the general structure of an amino acid and label the groups that are used in peptide bond formation.

(4)

b. Explain how a change in the primary structure of a globular protein may result in a different three-dimensional structure.

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(3)

c. Proteins form part of numerous cellular components, one of which is the plasma membrane. Give **TWO** functions of proteins in the plasma membrane.

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(2)

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d. Proteins also make up enzymes. Describe the role of enzymes in the cell by referring to activation energy.

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(1)

**(Total: 10 marks)**

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SUBJECT:	<b>Biology</b>
PAPER NUMBER:	II
DATE:	30 <sup>th</sup> August 2022
TIME:	9:00 a.m. to 12:05 p.m.

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### Directions to Candidates

- Answer the question in Section A, any **TWO** questions from Section B and **ONE** question from Section C. Write all your answers in the separate booklet provided.
  - If more than two questions from Section B are attempted, only the first two answers shall be taken into consideration.
  - If more than one question from Section C is attempted, only the first answer shall be taken into consideration.
  - The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
  - You are reminded of the necessity for good English and orderly presentation in your answers.
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  - The use of electronic calculators is permitted.
-

**SECTION A**

1. Read carefully the following extract. Then using the information provided and your knowledge of Biology, answer the questions that follow. The numerals in the left-hand margin are the line numbers.

**The truth about photosynthetic systems**

Photosynthesis is a process that converts light energy into organic molecules mainly carbohydrates symbolized as  $\text{CH}_2\text{O}$ . To estimate the efficiency of this process, two main factors must be appreciated.

5 Although phototrophs can efficiently trap light energy at all wavelengths due to certain pigments within them, the energy used for splitting water and reducing  $\text{CO}_2$  is only equivalent to the red region of the spectrum.

10 For every electron/proton extracted from water and used to reduce  $\text{CO}_2$ , the energy of two 'red' photons is required. This is accomplished by linking together two different photosystems, photosystem II (PSII), which uses light to power the extraction of electrons/protons from water, and photosystem I (PSI), which uses light to provide additional energy to the 'PSII-energized' electrons/protons so as to drive  $\text{CO}_2$ -fixation. Together, they are responsible for the synthesis of ATP.

15 In photosynthesis, the energy of at least eight 'red' photons is required per  $\text{O}_2$  molecule released or  $\text{CO}_2$  molecule fixed. A typical product of carbon fixation is glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ), which requires a proportional number of photons to synthesise, assuming a wavelength of 680 nm, giving the efficiency of conversion at about 30%.

20 Although this is an impressive number, in reality, the overall conversion of solar energy to glucose and the very large variety of other organic molecules that constitutes biomass, is much lower. For example, when taking into consideration action spectra, energy is lost through degrading shorter wavelength light to the energy of 'red' photons by saturation processes and more significantly, in driving the enormous number of reactions that occur in photosynthetic organisms to maintain their organization. Taking these various factors into account, the estimated maximum efficiency of photosynthesis decreases to 4.5%.

25 On a global basis, the efficiency of photosynthesis is significantly lower in areas used for agricultural and energy crops or algal cultures growing under optimal conditions because of temporal and annual changes and the existence of large portions of land and oceans on our planet that do not sustain significant levels of photosynthetic activity. Thus, the rate of energy storage averaged over a year by photosynthesis represents just 0.1% conversion given the solar energy arriving at our planet

30 This energy is mainly stored in wood and fibres of terrestrial trees and plants. Therefore, an approximate efficiency of global photosynthesis is 0.2% but with only half being stored in biomass. Of course, it was terrestrial biomass that was the major source of energy for humankind prior to the exploitation of fossil fuels. It is not surprising, therefore, that there is now a growing interest in returning to the use of biomass and biofuels as an alternative to fossil fuels, because  
35 their production and use is  $\text{CO}_2$  neutral.

*(Adapted from <https://royalsocietypublishing.org>)*

- a. Give **TWO** examples of pigments that enable photosynthesis to occur. (2)
- b. Briefly explain how PSII and PSI bring about the formation of ATP. (4)
- c. Where within the plastid is CO<sub>2</sub> fixed? Provide **ONE** reason why fixation occurs there. (2)
- d. Line 13-14 states that the energy of at least eight 'red' photons is required per O<sub>2</sub> molecule released or CO<sub>2</sub> molecule fixed. What is the minimum number of photons of light required to synthesise one glucose molecule? Show your working. (2)
- e. Distinguish between action spectrum and absorption spectrum. (2)
- f. Why are wavelengths shorter than 680 nm still absorbed by the plastid? (2)
- g. Lines 19 to 23 refer to reactions that negatively impact productivity. List **TWO** processes that negatively impact productivity. (2)
- h. Explain why temporal and annual changes affect the productivity of photosynthesis. (2)
- i. Which portions of land and oceans are being referred to in line 26-27? Give a reason why such areas influence photosynthetic productivity. (2)
- j. The 0.1% of photosynthetic energy stored within biomass is considered as unusable energy for the ecosystem. Provide **TWO** reasons why this is so. (2)
- k. Biofuel is any fuel that is derived from biomass, that is, plant or algae material or animal waste. How does the use of biofuel as alternative to fossil fuels impact the carbon cycle? (3)

**(Total: 25 marks)**

## **SECTION B**

**Answer any TWO questions from this section; your answers should take the form of essays. Each question carries twenty five marks.**

1. Describe the role that the controller (or regulator), effector and receptor (or detector) play within control systems. Use clear examples to support your argument.
2. Provide an overview of the metabolic pathways associated with aerobic respiration which follow glycolysis.
3. Allosteric inhibition regulates the expression of certain proteins. Discuss.
4. Provide an overview of how active immunity and passive immunity operate in the body.

**(Total: 50 marks)**

***Please turn the page.***

### SECTION C

Answer ONE question from this section.

1. Use your knowledge of Biology to explain the following statements:

- a. Originally, symbiosis was defined as a close relationship between two or more organisms of different species in which all partners benefit. However, biologists have been increasingly aware that the exact degree of closeness, benefit, or harm in a relationship between different species is very variable. (5)
- b. *Chthamalus* sp. is generally only found in the high tide zone where it is most competitive. However, if the neighbouring *Semibalanus* sp. is removed, *Chthamalus* sp. can actually occupy the entire intertidal zone. (5)
- c. The abiotic features within the Maltese coastal habitats give rise to different zones which are in turn characterised by adequately adapted organism. (5)
- d. The carbon cycle on Mars proceeds at a much slower rate than it does on Earth. This is due to the lack of organisms living on Mars. (5)
- e. The maximum number of individuals in a population is limited by the number of individuals themselves. (5)

**(Total: 25 marks)**

**OR**

2. Use your knowledge of Biology to explain the following statements:

- a. Transition from marine habitat to terrestrial ones impacted gaseous exchange systems. (5)
- b. Triploblastic organisation gave rise to even more complex organ systems. (5)
- c. Breakdown of lipids requires the action of bile salts and an enzyme. (5)
- d. The genetic code is a triplet, degenerate and non-overlapping code. (5)
- e. During the 1800s, Northern elephant seals were nearly hunted to extinction for their oil-rich blubber. Thus, overhunting drastically reduced the population size and later generations experienced a lack of genetic variation. (5)

**(Total: 25 marks)**



**L-Università  
ta' Malta**

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE  
EXAMINATIONS BOARD

**ADVANCED MATRICULATION LEVEL  
2022 SECOND SESSION**

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SUBJECT: **Biology**  
 PAPER NUMBER: III  
 DATE: 31<sup>st</sup> August 2022  
 TIME: 9:00 a.m. to 12:05 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.
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- 

### For examiners' use only:

Question	1	2	3	1	Total
Score					
Maximum	21	16	13	40	<b>90</b>

**SECTION A: Answer ALL questions.**

1. This question is about the nervous system.

An experiment was carried out to study the action potential conduction velocities of two different giant fibers in an earthworm. As shown in Figure 1, the earthworm has one medial giant fiber (MGF) and two lateral giant fibers (LGFs), which are fused together and considered as one giant axon.

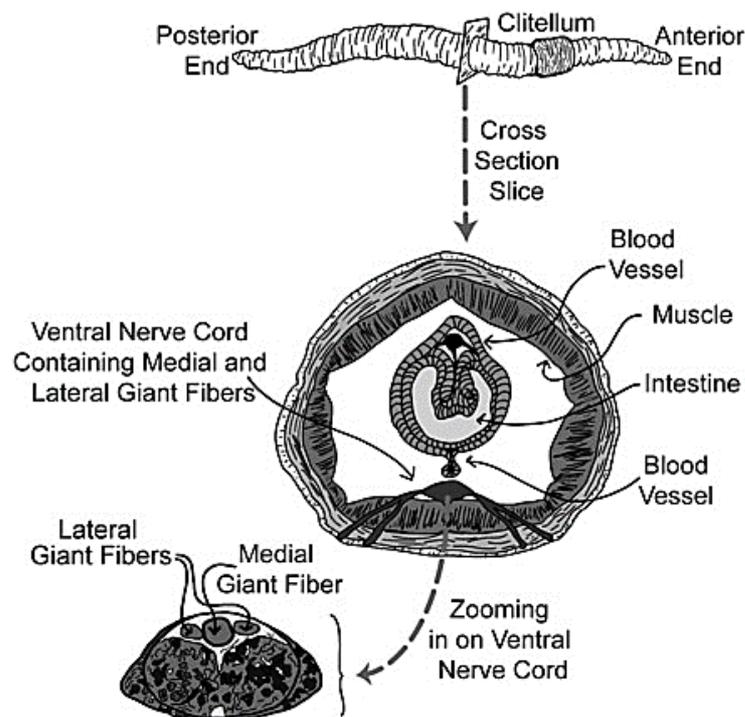


Figure 1: A cross-section through the ventral nerve cord of the earthworm, showing the lateral giant fibers (LGFs) and medial giant fiber (MGF).

(Obtained: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4116350/figure/F1>)

The LGF transmits sensory information from the posterior end of the earthworm while the MGF transmits sensory information from the anterior end. The diameter of these giant fibers is **0.05 mm** for the LGF and **0.07 mm** for the MGF.

The earthworm was anesthetized and placed dorsal side up. Three electrodes were inserted into the posterior end of the worm; the distance between electrodes 1 and 2 ( $d_{LGF}$ ) was measured as **2.54 cm** and the third electrode was used as a reference. To study the conductivity through the LGF, the very posterior end of the earthworm was tapped gently with a glass rod. Three spike signals and time differences between the two electrodes were recorded.

The electrodes were repositioned to the anterior end of the worm to record conduction from the MGF. The distance between electrodes 1 and 2 ( $d_{MGF}$ ) was again recorded as **2.54 cm**, and the anterior end of the worm was tapped gently to trigger the spiking response.

Figure 2 shows the resulting spikes generated by the two axon-types. The time that elapsed between the two electrodes for LGF ( $t_{LGF}$ ) was recorded as **3.5 milliseconds**, while the time difference between the two electrodes in the MGF spike ( $t_{MGF}$ ) was **1 millisecond**.

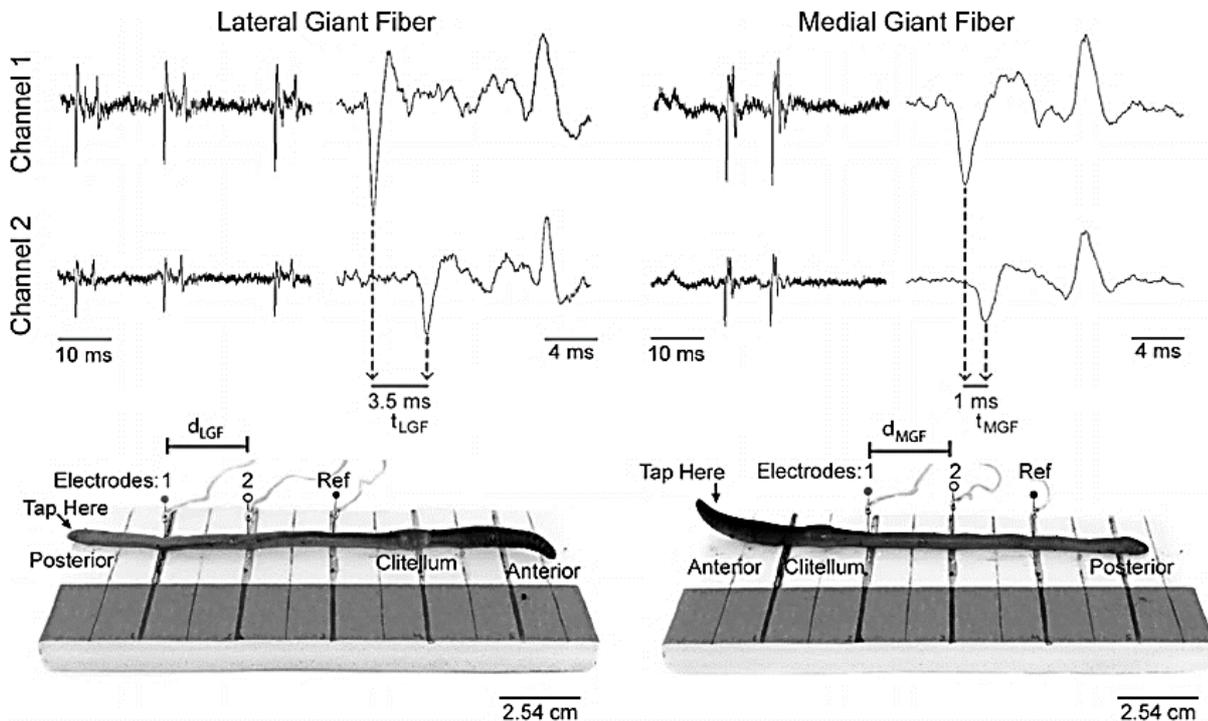


Figure 2: Results

(Obtained: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4116350/figure/F3/>)

- a. Using the results obtained in this experiment and the equation below, calculate the conduction velocity for the Lateral Giant Fiber and the Medial Giant Fiber of this earthworm.

$$\text{conduction velocity (m/s)} = \frac{\text{distance (measured between electrodes) (in meters)}}{\text{time (elapsed between electrodes) (in seconds)}}$$

Lateral Giant Fiber:

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(2)

**Question continues on next page.**

Medial Giant Fiber:

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(2)

b. Using the results obtained and the information provided, how do you explain the different action potential conduction velocities of these two axon types?

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(4)

The presence or absence of myelin is another factor that effects that rate of action potential conduction in nerve fibers. An experiment was carried out to study the conduction speed of myelinated and unmyelinated neurons with axons of different diameters. Table 1 shows the results of this experiment.

Table 1: Experiment Results

Neuron	Type	Diameter of Axon ( $\mu\text{m}$ )	Speed of Conduction (m/s)
1	Unmyelinated	2	2
2	Unmyelinated	15	5
3	Unmyelinated	700	22
4	Myelinated	10	30
5	Myelinated	15	80

c. What is myelin?

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(1)

d. Use the experiment results provided in Table 1 to:

i. explain the role of myelin in the conduction of impulses;

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

ii. compare the conduction speed of the myelinated and unmyelinated neurons with 15  $\mu\text{m}$  diameter.

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

Experimental pain models are frequently used to simulate pain when studying the action mechanisms or effectiveness of drugs and medical treatments. A stimulus applied to a body part activates pain receptors, triggering temporal and/or spatial summation, therefore resulting in pain sensations. The resulting simulations are used to assess the performance of painkillers.

Figure 3 shows one such experimental pain model, where pain is induced by heat stimulation on the skin. Model 1 shows the repetition of the heat stimulus every 4 seconds at the same site, resulting in a pain stimulus of constant intensity (VAS visual analogue scale for pain intensity). In model 2 the same stimulus was applied at a higher frequency (every 1 second). This resulted in a more intense pain sensation. PT refers to threshold potential.

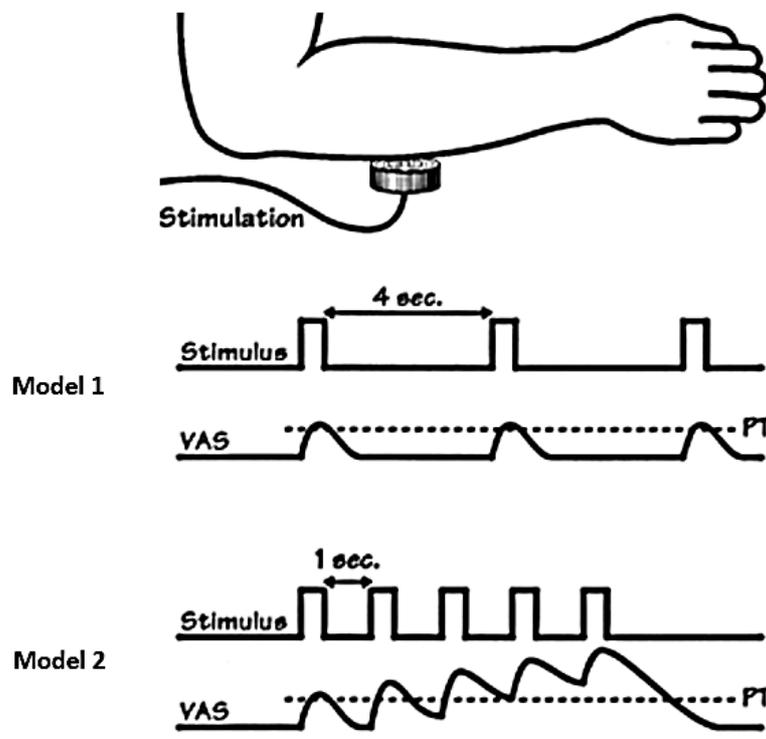


Figure 3: Experimental Pain Model  
 (Obtained: [https://core.ac.uk/reader/212371561?utm\\_source=linkout](https://core.ac.uk/reader/212371561?utm_source=linkout))

**Question continues on next page.**

e. Define temporal and spatial summation.

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(3)

f. Does the experimental model shown in Figure 3 represent spatial or temporal summation? Give a reason for your answer.

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(2)

g. Explain why models 1 and 2 resulted in different pain stimuli.

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(2)

**(Total: 21 marks)**

2. This question is about reproduction in mosses.

Mosses can reproduce both sexually and asexually. Sexual reproduction occurs by spore formation, when the male gametes are transferred to the female gametes for fertilization. Asexual reproduction, which is also known as vegetative reproduction, happens when parts of the plant break off and form new moss plants with identical genetic information. Asexual reproduction is an adaptation shown by these plants to ensure survival in the harsh environments they inhabit.

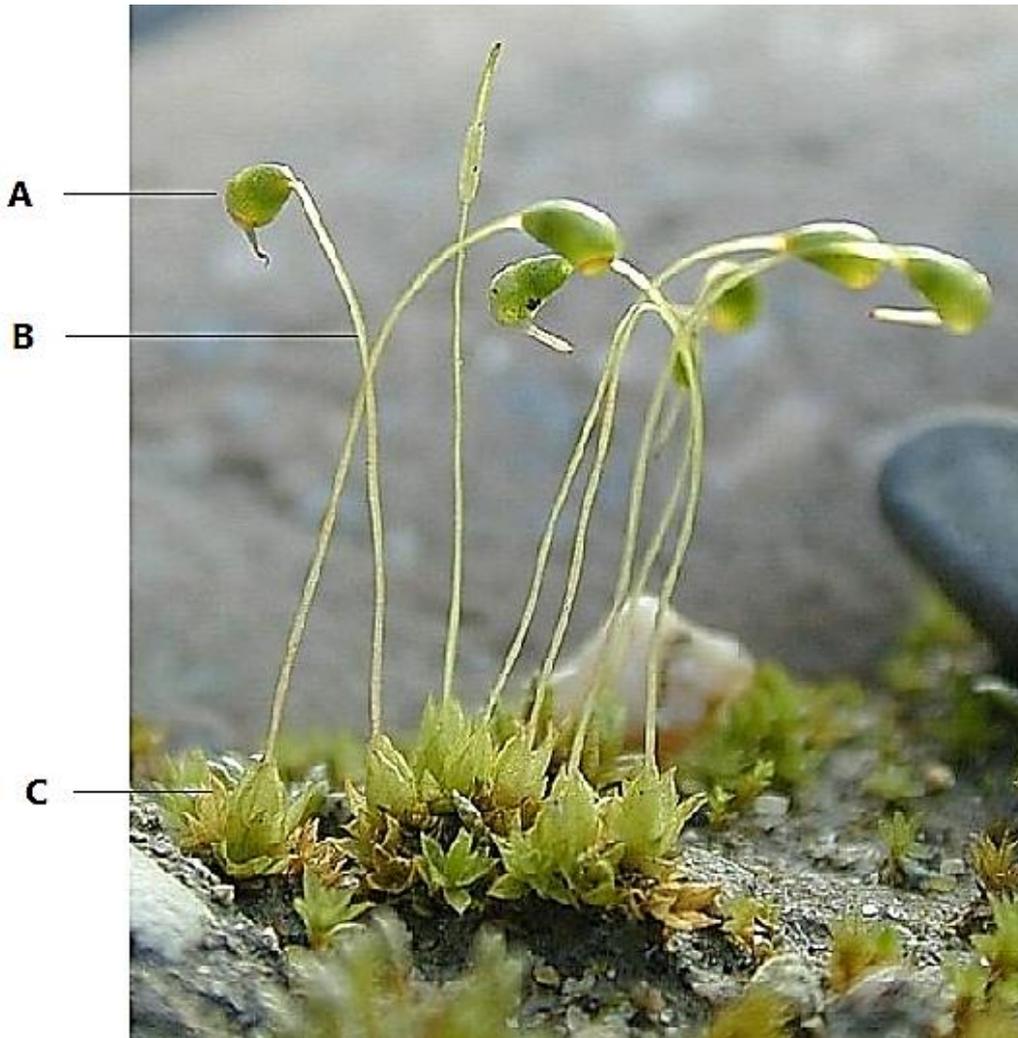


Figure 4: Funaria

(Obtained: <https://shortnotesinbotany.blogspot.com/2020/04/thallus-structure-of-funaria.html>)

a. Which kingdom and phylum/division does this species belong to?

Kingdom: \_\_\_\_\_

Phylum: \_\_\_\_\_

(1)

**Question continues on next page.**

b. Use the table below to indicate the labels and annotations associated with Figure 4.

Structure	Label	Annotation
A		
B		
C		

(3)

c. Figure 4 shows both the sporophyte and the gametophyte stages of this species. Label **each** stage on the diagram. (1)

d. Which of the two is the predominant stage in the life cycle of mosses?

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

e. Using the keywords provided, fill in the blanks to complete Figure 5 on the next page.

<b>KEYWORDS</b>				
spores	female gametophyte	sporangium capsule	haploid	antheridium
zygote	male gametophyte	diploid	meiosis	archegonium

(10)

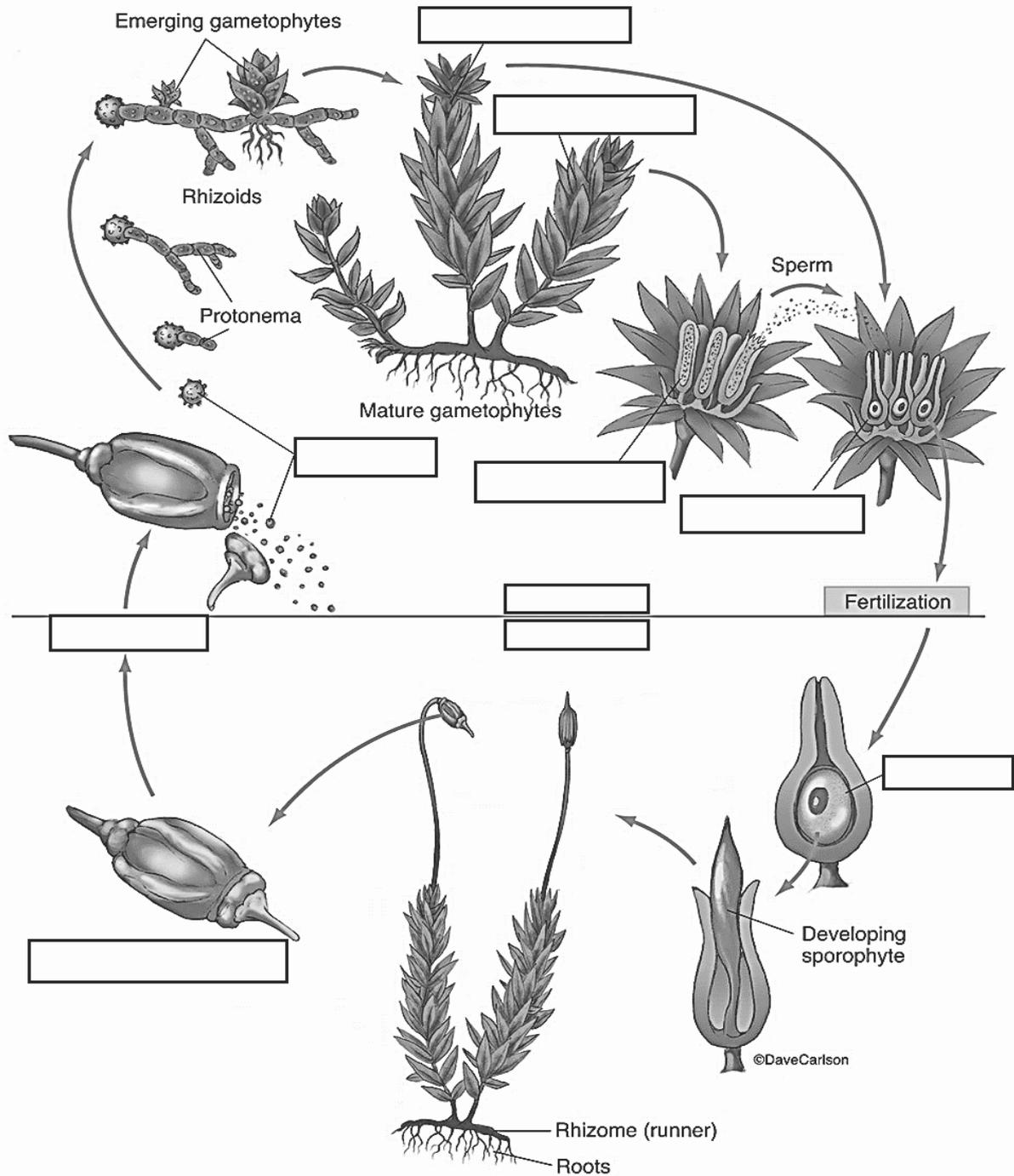


Figure 5: The Lifecycle of a Moss  
(Obtained: <https://www.carlsonstockart.com/images/xl/Moss-Life-Cycle.jpg>)

**(Total: 16 marks)**

**Questions continue on next page.**

3. This question is about Taxonomy.

a. The organisms shown in Figures 6 to 10 belong to the same Phylum. Identify the Phylum and Classes to which these organisms belong. (3)

Phylum: \_\_\_\_\_

Class of organism in:

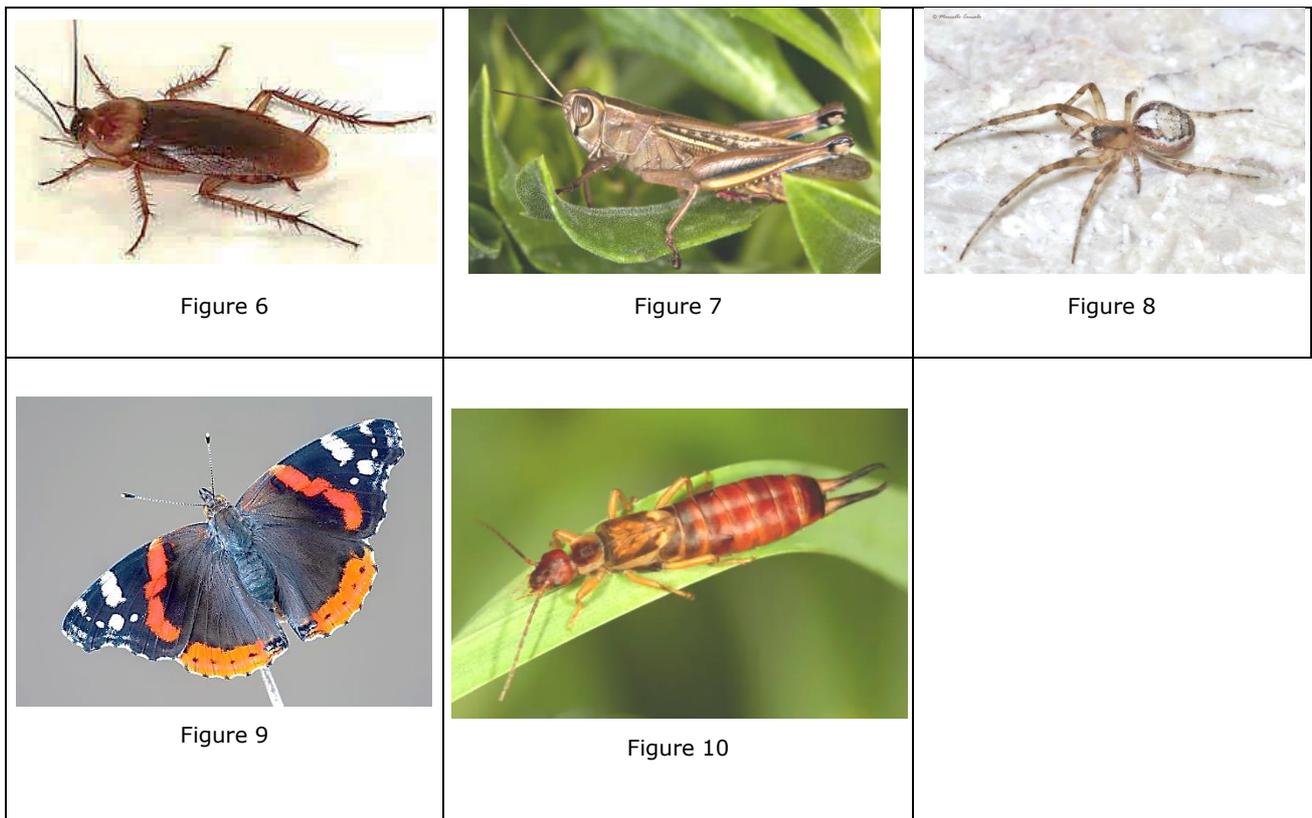
Figure 6; \_\_\_\_\_

Figure 7; \_\_\_\_\_

Figure 8; \_\_\_\_\_

Figure 9; \_\_\_\_\_

Figure 10. \_\_\_\_\_



b. Organisms in Figures 6, 8 and 10 undergo incomplete metamorphosis. Define this type of metamorphosis.

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



**Section B: Answer all parts of this question.**

Osmosis is the movement of water from a high-water potential to a low-water potential through a semi-permeable membrane until equilibrium is reached on both sides.

In this experiment, the % change in weight of the dialysis tubing (semi-permeable membrane) needs to be compared for different concentrations of sucrose.

Devise an experiment to find the % change in weight of the dialysis tubing when filled separately with four different concentrations of sucrose, namely 10 %, 8 %, 5 % and 1 %.

You are provided with the following materials:

- Lengths of 15 cm dialysis tubing (to fill up to a maximum of 10 ml solution)
- Beakers
- Funnel
- Rubber bands
- 10 % sucrose stock solution
- Distilled water
- Stopwatch
- Weighing balance
- Measuring cylinder

The diagram below shows the setup of the experiment.

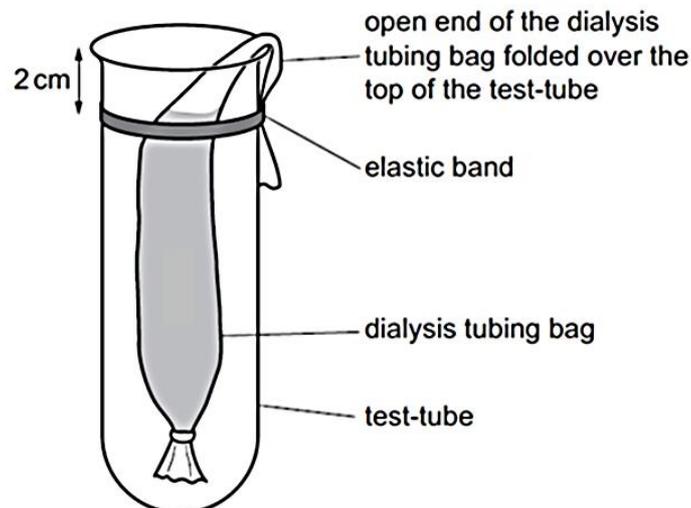


Figure 11: Dialysis Tubing Setup

(Adapted: 0610 QR Dynamic Papers Biology of Cambridge (qrpastpapers.com))



Table 2 below shows the weight of the dialysis tubing in different sucrose concentrations, at 15-minute intervals.

Table 2: Table of results showing weight of dialysis tubing at 15-minute intervals.

% Sucrose	Weight at T <sub>0min</sub> in grams	Weight at T <sub>15min</sub> in grams	Weight at T <sub>30min</sub> in grams	Weight at T <sub>45min</sub> in grams	Weight at T <sub>60min</sub> in grams	% change in weight at 60 min
0	10	10	10	10	10	
1	10	10	10	11	11	
5	10	10	11	12	15	
8	10	12	14	15	16	
10	10	12	15	17	19	

d. From the data given in the table of results, work out the % change in weight of the dialysis tubing at 60 minutes for all sucrose concentrations. Show your working and write your answer in the table of results.

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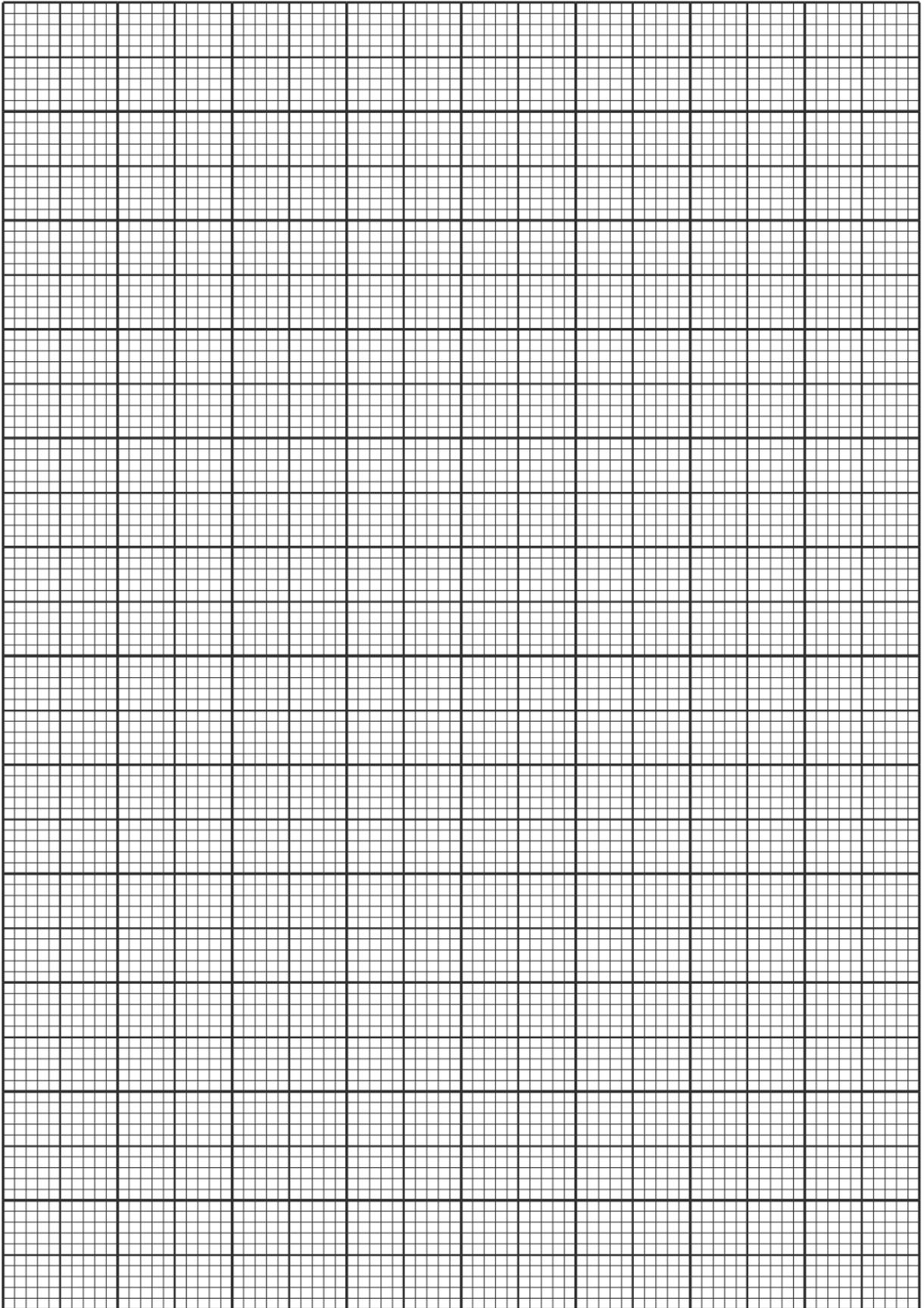
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(5)

e. Use the graph paper provided on the next page to plot a graph of the % change in weight of dialysis tubing vs % sucrose concentration. (6)



***Question continues on next page.***

f. List and justify **TWO** precautions for this investigation.

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(2)

g. List and justify **TWO** errors for this investigation.

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(2)

h. Briefly describe any trends that emerge from your graph.

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(3)

i. Use your biological knowledge to give a detailed explanation of the results. Use the terms hypertonic, hypotonic and isotonic in your explanation.

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(3)

- j. Which molecule moved across the dialysis membrane to produce the weight changes observed? Give **ONE** chemical test that confirms your conclusion.

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(2)

**(Total: 40 marks)**

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