Index Number:_____ IM05.22m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

INTERMEDIATE MATRICULATION LEVEL
2022 FIRST SESSION

SUBJECT:	**Biology**
DATE:	10th May 2022
TIME:	4:00 p.m. to 7:05 p.m.

Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** questions in Section A and **TWO** questions from Section B.
- Write all your answers to questions from Section A in the spaces provided in this booklet. Candidates are advised that under no circumstances should answers to Section A be submitted in the separate answer booklet provided.
- Write all your answers to questions from Section B in the separate answer booklet provided.
- If more than two questions from Section B are attempted, only the first two answers 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.
- 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	10	**Total**
Score											
Maximum	**13**	**10**	**10**	**11**	**6**	**25**	**25**	**25**	**25**	**25**	**100**

SECTION A: Answer ALL questions in this section.

1. This question is about prokaryotic and eukaryotic cell structure.

   a. Prokaryotic cells are the simplest of all cells. In the space below draw a generalised diagram of a prokaryotic cell. Label your drawing. (5)

   b. Which of the five kingdoms of organisms consist of cells which are prokaryotic?

   _____ (1)

   c. Eukaryotic cells evolved from prokaryotic cells. What is the main distinguishing feature between a prokaryotic and eukaryotic cell?

   _____

   _____ (1)

d. Mention **THREE** structural features which are present in plant cells but absent in animal cells. Give **ONE** function for each of these features.

Structural Feature 1:_____

Function: _____

_____ (2)

Structural Feature 2: _____

Function: _____

_____ (2)

Structural Feature 3: _____

Function: _____

_____ (2)

(Total: 13 marks)

2. This question is about the cell surface membrane.

a. Name and describe the structure of the molecule which forms the basic framework of the cell membrane.

_____

_____

_____ (2)

b. What is meant by the terms:

i. hydrophobic;

_____(0.5)

ii. hydrophilic.

_____(0.5)

Question continues on next page.

c. Which parts of the molecule you described in part (a), are:

i. hydrophobic;

_____ (1)

ii. hydrophilic.

_____ (1)

d. Explain how the properties described in part (c), enable the membrane to assemble into a bi-layer.

_____

_____

_____ (2)

e. Several proteins are found embedded within the cell membrane. Some of these proteins are responsible for the transport of substances across the membrane.

i. What is facilitated diffusion?

_____

_____ (2)

ii. Name a molecule or ion which passes through the membrane by facilitated diffusion.

_____ (1)

(Total: 10 marks)

3. Read the following article and answer the questions that follow.

It has been 100 years since the first report of sickle haemoglobin. More than 50 years ago, it was suggested that the **gene** responsible for this disorder could reach high frequencies because of resistance conferred against malaria by the heterozygous carrier state. Sickle haemoglobin, a structural variant of normal adult haemoglobin, results from a single base substitution. When the sickle haemoglobin gene is inherited from only one parent, the heterozygous child is usually an asymptomatic carrier. When inherited from both parents, the homozygous child suffers from sickle cell anaemia. Without treatment, which is rarely available in low-income countries, the vast majority of children born with sickle cell anaemia die before the age of 5 years. **Natural selection** should therefore have removed this mutation from human populations, but **allele** frequencies of sickle haemoglobin in excess of 15% have been observed.

(Adapted from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3060623/#S1)

a. Define the following terms as used in the article above.

i. gene;

_____

_____ (1)

ii. allele.

_____

_____ (1)

b. Several types of mutations can occur and these result in a change of the DNA sequence. Name the type of gene mutation which gives rise to sickle cell anaemia.

_____ (1)

c. Briefly describe the consequence of this type of mutation with respect to transcription and translation.

Transcription: _____

_____

_____

_____

_____

_____ (2)

Translation: _____

_____

_____

_____

_____

_____ (2)

d. Sickle cell anaemia is an example of a gene mutation. Chromsomal mutations are another type of mutation. Give an example of a disorder that arises from a chromosomal mutation.

_____ (1)

Please turn the page.

e. In the last sentence of the text, the term natural selection is mentioned. Briefly explain why mutations are important for the process of natural selection.

_____

_____

_____

_____

_____ (2)

(Total: 10 marks)

4. This question is about Ecology.

Figure 1 shows an example of a real-world wild population growth curve of harbour seals.

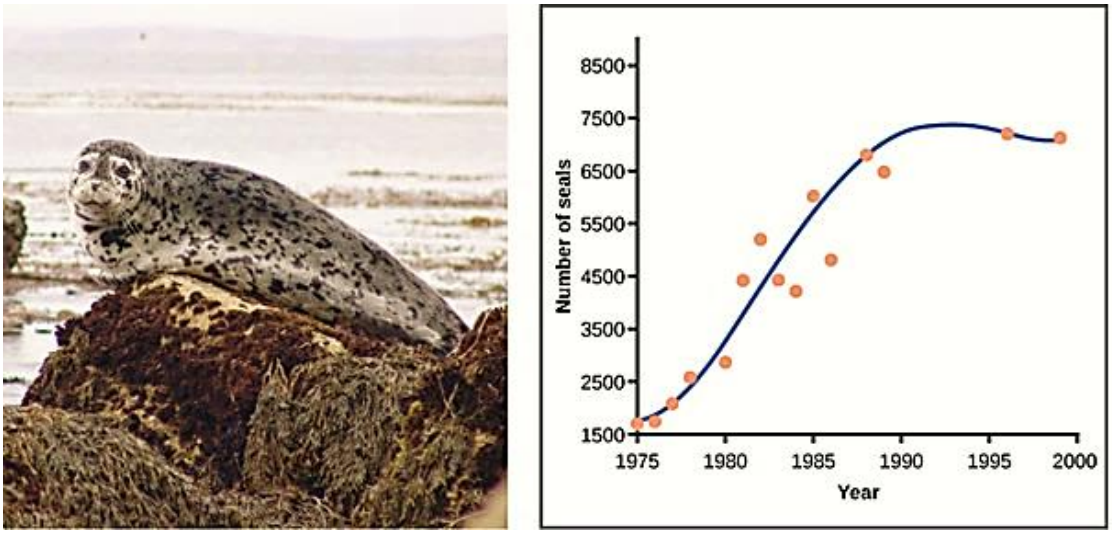

Figure 1: Population growth curve of harbour seals

(Adapted from: https://courses.lumenlearning.com/wm-biology2/)

a. Define the following terms:

i. population;

_____

_____ (1)

ii. species.

_____

_____ (1)

b. Name the type of population growth curve for the harbour seal population as shown in the graph in Figure 1.

_____ (1)

c. Name **ONE** process that increases population size and **ONE** process that decreases population size.

Process that increases population size: _____ (1)

Process that decreases population size: _____ (1)

d. Using Figure 1 give the value of the carrying capacity (K), expressed as number of seals, for this harbour seal population.

_____ (1)

e. Name **TWO** factors that limit population growth up to the environment's carrying capacity.

_____ (2)

f. Consider the three phases shown on the population growth curve. Give **ONE** reason for each observed phase on the graph.

Exponential growth phase: _____

_____

_____

_____ (1)

Transitional phase: _____

_____

_____

_____ (1)

Plateau phase: _____

_____

_____ (1)

(Total: 11 marks)

Please turn the page.

5. This question is about diversity of life.

Give the name of **ONE** Kingdom that fits each of the following descriptions:

Description	Kingdom
Organisms are saprophytic and are made up of hyphae	
Organisms are phagotrophic	
Organisms produce flowers	
Organisms are photosynthetic	
Organisms have a backbone	
Organisms lack complex organ systems	

(Total: 6 marks)

SECTION B:

Answer any TWO questions from this section; each question carries 25 marks. If more than two questions are attempted, only the first two answers shall be taken into consideration.
Write all your answers to questions from this section in the separate answer booklet provided.

6. This question is about enzymes.

a. What are enzymes? (2)

b. Enzymes work by a process known as the lock-and-key model. Describe this process and include a simplified diagram to further explain your answer. (8)

c. Enzymes are sensitive to temperature. Explain how the rate of enzyme activity is affected by temperature. Include a generalised graph of the rate of enzyme activity against temperature to fully explain your answer. (5)

d. Enzymes are also directly affected by the substrate concentration. Explain how the rate of enzyme activity is affected by substrate concentration and include a generalised graph of rate of enzyme activity against substrate concentration to fully explain your answer. (5)

e. Enzymes are highly affected by inhibitors. Enzyme inhibitors can be competitive or non-competitive inhibitors. Explain how each type of inhibitor affects enzyme activity. (5)

(Total: 25 marks)

7. This question is about cellular respiration. Cellular respiration is the process by which food, in the form of glucose, is transformed into energy within cells.

   a. Glucose is a type of carbohydrate called a monosaccharide. There are three different categories of carbohydrates: monosaccharides, disaccharides and polysaccharides.
      i. Define the terms: monosaccharide; disaccharide; and polysaccharide. (3)
      ii. Give an example of a biomolecule for each category of carbohydrate, excluding glucose and list **ONE** function for each example given. (6)

   b. Two types of cellular respiration may occur, these include aerobic and anaerobic respiration. Compare and contrast these two types of cellular respiration processes. (10)

   c. Mitochondria are membrane-bound organelles that power the cell's biochemical reactions. Draw and label the structure of a mitochondrion. (6)

(Total: 25 marks)

8. This question concerns human impact on the environment.

   Urban outdoor air pollution and nitrate concentrations in ground water appear to be of health and environmental concern in Malta, additionally asthma prevalence in Malta is above the European Region average according to the WHO, 2009 report. The sustainable development strategy is one main framework that aims to reduce these negative impacts.

   (Adapted from: https://www.euro.who.int/__data/assets/pdf_file/0006/95343/E93547.pdf)

   a. *'Urban outdoor air pollution and nitrate concentrations in ground water'* are both types of environmental pollution.
      i. Describe the sources of environmental pollution. (4)
      ii. Discuss the negative effects of environmental pollution including the effects of greenhouse gases on the environment. (4)

   b. List **THREE** practical ways in which environmental pollution can be reduced during our everyday life. (3)

   c. Loss of biodiversity is one of the main global issues related to human impact on the environment. Discuss how biodiversity loss is brought about through the various human activities. (8)

   d. Environmental management through effective conservation measures reduces the negative human impacts on our natural resources. Discuss how conservation techniques can help to protect and conserve the natural environment. (6)

(Total: 25 marks)

Please turn the page.

9. This question is about the immune system.

   a. Describe and explain **FIVE** ways by which the skin and mucous membranes prevent the entry of pathogens into the body. (5)

   b. Distinguish between non-specific and specific immune responses. (5)

   c. Antibodies are produced in humoral immunity in response to an antigen. Explain this statement by:

      i. defining the term antigen; (3)

      ii. explaining in detail how antibodies are produced in the humoral response. (9)

   d. Why does the immune system respond so quickly when it encounters a pathogen a second time? (3)

(Total: 25 marks)

10. This question is about the nervous system.

   a. Define the term resting potential. (4)

   b. Impulses travel down a neuron by the generation of action potentials. Explain the stages involved in the generation of an action potential. (5)

   c. The same action potential does **not** itself travel down the neuron but it propagates itself. Explain this statement. (3)

   d. Describe in detail how electrical impulses pass from one neuron to the next. (7)

   e. Explain the effect of drugs such as nicotine and amphetamines on synaptic transmission. (6)

(Total: 25 marks)

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