Index No:_____ **IM05.17m**

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
INTERMEDIATE LEVEL
MAY 2017

SUBJECT:	BIOLOGY
DATE:	8th May 2017
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	11	**Total**
Score												
Maximum	**6**	**9**	**7**	**11**	**6**	**11**	**25**	**25**	**25**	**25**	**25**	**100**

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SECTION A: Answer ALL questions in this section.

1. This question is about organelles.

a. What is an organelle?

_____ (1)

b. List **ONE** organelle found in both prokaryotic and eukaryotic cells.

_____ (1)

c. Give **ONE** function of the following organelles:

i. lysosome;

_____ (1)

ii. Golgi apparatus;

_____ (1)

iii. rough endoplasmic reticulum.

_____ (1)

d. Place the following in **ascending** order of size:

Virus, plant cell, organelles, bacterial cell and animal cell.

_____ (1)

(Total: 6 marks)

2. This question is about chromosomal structure.

a. What is a eukaryotic chromosome?

_____ (1)

b. The DNA molecule is a polymer. What is the name of the monomer that makes up DNA?

_____ (1)

c. Name the **THREE** constituents of the monomers that make up DNA.

_____

_____ (3)

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d. Draw a diagram showing the spatial arrangement of a single DNA strand, showing the positions of the sugars, phosphates and bases.

(4)

(Total: 9 marks)

3. This question is about the human immune system.

The diagram below illustrates how a lymphocyte in a lymph node multiplies and differentiates to form memory cells and plasma cells. This type of lymphocyte produces antibodies which bind to antigens.

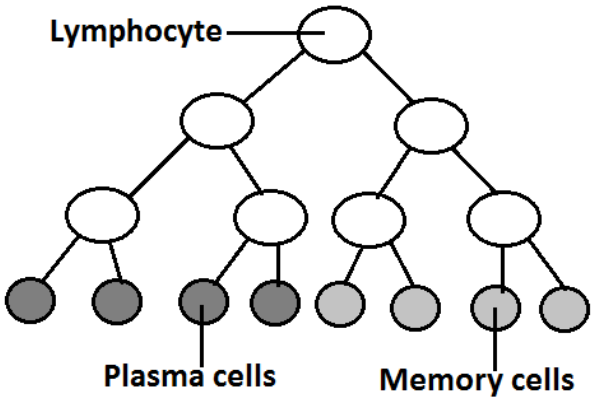

Figure 1: Lymphocyte division and differentiation

a. Name the type of lymphocyte shown in Figure 1.

(1)

b. Name the type of immunity these cells are involved in.

(1)

c. Briefly describe the relation between plasma cells and antigens.

(3)

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d. Two brothers are both coughing. One child has been diagnosed with pneumonia. He is prescribed antibiotics. The other brother is suffering from viral bronchitis and he is not prescribed antibiotics. Explain why one of the children is given antibiotics, whilst the other isn't.

(2)

(Total: 7 marks)

4. This question is about the human nervous system.

a. Neurons are specialised cells of the nervous system. The three major types of neurons are shown in Figure 2.

On Figure 2 label the following:

i. the cell body of the sensory neuron;
ii. the cell body of the motor neuron;
iii. the intermediate neuron;
iv. an axon;
v. dendrites. (5)

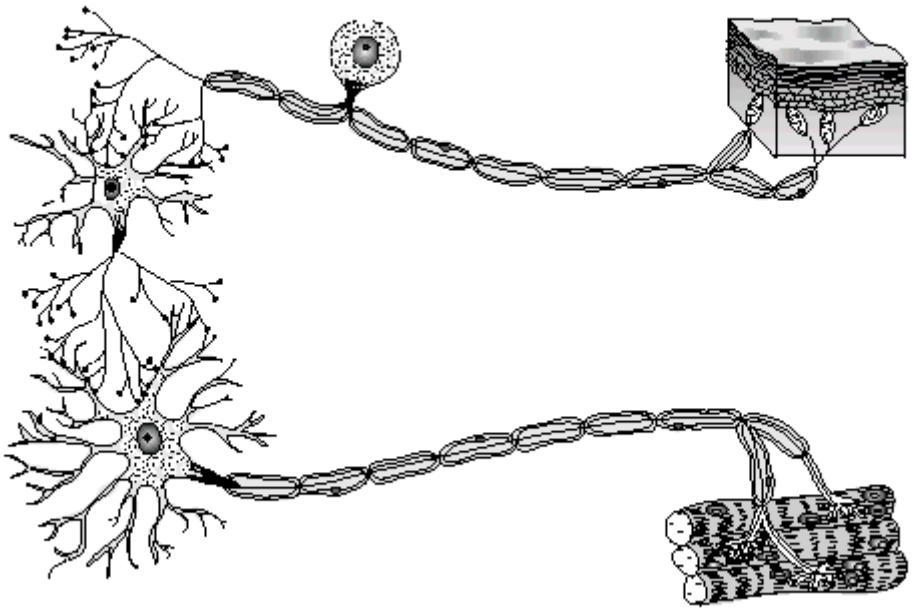

Figure 2: The three types of neurons

(Picture taken from: http://erichamber.ca/departments/science/dfung/pages/biology/nervesys.htm)

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b. Give the function of:

i. the sensory neuron;

_____

_____ (1)

ii. the motor neuron;

_____

_____ (1)

iii. the intermediate neuron.

_____

_____ (1)

c. Distinguish between the resting potential and the action potential.

_____

_____

_____

_____ (3)

(Total: 11 marks)

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5. This question is about gene technology.

All viruses attack their hosts and introduce their genetic material into the host cell as part of their replication cycle. This genetic material contains basic 'instructions' of how to produce more copies of these viruses. Viruses can be genetically engineered and made to act as vectors which can be used as vehicles to carry 'good' genes into a human cell. Many gene therapy clinical trials rely on retroviruses to insert the desired gene into a host cell.

a. What is *gene therapy?*

_____

_____

_____ (2)

b. Define the term *vector* in the context above.

_____

_____ (2)

c. Mention another vector, apart from viruses, that can be used in genetic engineering.

_____ (1)

d. Mention another current application of Genetic Engineering other than gene therapy.

_____ (1)

(Total: 6 marks)

6. This question concerns human digestion and nutrition.
Figure 3 shows a section of the alimentary canal of a human.

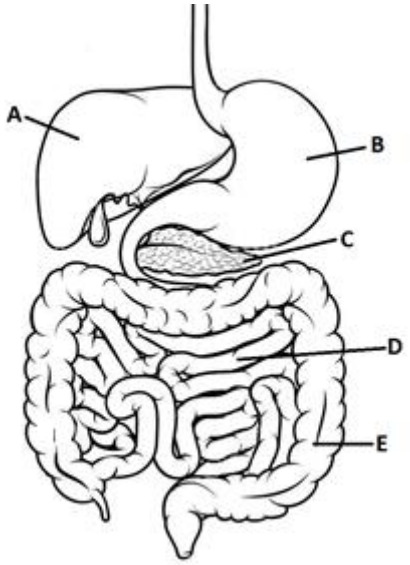

Figure 3: Human alimentary canal
(Picture taken from: http://stockfresh.com/files/k/krisdog/m/38/6452223_stock-vector-human-digestive-tract.jpg)

DO NOT WRITE ABOVE THIS LINE

a. Identify the labelled organs A to E in Figure 3 and fill in the table below. The first one has been done for you.

Organ Label	Name	One Function
A	*Liver*	*Bile production*
B		
C		
D		
E		

(8)

b. Name an enzyme produced by the body that digests starch.

_____ (1)

c. Name an enzyme produced by the body that digests fats.

_____ (1)

d. Name an enzyme produced by the body that digests proteins.

_____ (1)

(Total: 11 marks)

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SECTION B

Answer any TWO questions from this section; each question carries twenty-five 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.

7. This question concerns respiration.
Cellular respiration is a set of metabolic reactions and processes that take place in the cells of organisms to convert biochemical energy from nutrients into chemical energy – ATP.

a. What is ATP? (3)

Aerobic and anaerobic respiration are means of ATP production.

b. Compare and contrast the processes of aerobic and anaerobic respiration. (10)

c. How is ATP produced during respiration? (6)

d. Sodium azide is a substance that inhibits oxidative phosphorylation by inhibiting the final enzyme in the mitochondrial electron transport chain. A student conducted an investigation on respiration with sodium azide.

Suggest and explain how the addition of sodium azide would result in:

i. a rapid depletion of intracellular ATP;
ii. an increase in glucose;
iii. a decrease in pyruvate levels. (6)

(Total: 25 marks)

8. This question concerns genetic mutations.

Give explanations for the following statements:

a. Downs' Syndrome is caused by a random error in cell division that results in a mutation. (8)

b. The structural abnormality of haemoglobin (Hb)S in sickle cell anaemia results from a single amino acid replacement during protein synthesis. (9)

c. Genetic mutations are the driving force of evolution. (8)

(Total: 25 marks)

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9. The following statements are linked to human impact on the environment.
Explain the biological observations presented in italics.

a. Tropical rainforests took between 60 and 100 million years to evolve and are believed to be the oldest and most complex land-based ecosystem on earth. *Nowadays rapid destruction of rainforests is disrupting the global climate, reducing soil fertility and leading to loss of biodiversity.* (10)

b. Each Member State of the European Union has the obligation under the EC Habitats Directive of contributing to the creation of the Natura 2000 network. Malta has various Natura 2000 sites of national importance. *These sites require the need of conservation strategies as various forms of life are continuously exposed to threats that could lead to their extinction. Various actions are taken to promote conservation.* (7)

c. The major fraction of waste that used to arrive at the landfills in Magħtab in Malta and Qortin in Gozo, was inert waste generated from industrial rock excavations and construction. The rest was household waste. *These landfills have decreased in size in recent years as more sustainable methods of (i) treatment of industrial waste, (ii) treatment of hazardous and bulky material and (iii) disposal of household waste have been established in order to reach targets imposed on Malta by the European Union.* (8)

(Total: 25 marks)

10. This question is about cell division.

All cells arise from pre-existing cells. Cells undergo cell division which includes three phases.

a. What is the cell cycle? (2)

b. Describe the **THREE** main phases of the cell cycle. (9)

c. The quantity of genetic material (DNA) within the cell varies during the phases of the cell cycle. Discuss this statement. (5)

d. What is the difference between mitosis and meiosis in terms of their biological significance? (5)

e. Which of the two processes, mitosis or meiosis, generates biological diversity more rapidly? Explain your reasoning. (4)

(Total: 25 marks)

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11. This question concerns the chemistry of life.

a. Proteins are polymers of amino acids.

i. Draw a simple diagram to show the generalised structure of an amino acid. (3)

ii. When two amino acids bond a dipeptide molecule is formed. Draw a simple diagram to show the structure of a dipeptide. Draw a circle round the bond formed between the two amino acids and name the bond. (6)

iii. Name **ONE** fibrous protein and **ONE** globular protein and give their respective functions. (4)

b. Carbohydrates can be divided into three main groups depending on the amount of monomer sugar units they are made out of. Name these **THREE** groups and name **ONE** sugar found in each group and give a function for each sugar you mention. (9)

c. Polymers are large molecules made up of chains of monomers. Using a named example, outline how polymers are produced from monomers. Name the reaction that is taking place. (3)

(Total: 25 marks)

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