

LUSAKA APEX
MEDICAL UNIVERSITY



FACULTY OF PRE-MEDICAL SCIENCES

UNIVERSITY EXAMINATIONS MAY 2023

BS 1001

CELLS AND BIOMOLECULES

MONDAY 15TH MAY 2023

DURATION: Three Hours

TOTAL MARKS: 100

Examiners: Ms. K Malisa, Dr. G. Chakolwa and Ms. A. Chawe

INSTRUCTIONS FOR THE WHOLE PAPER

1. Write your Student Identity Number on all pages of the answer booklet(s).
2. Answer ALL the questions in this paper.
3. Present your work in a clear and logical manner.
4. All drawings should be in pencil.
5. Any disregard for examinations rules and regulations will result in you being disqualified from this examination.
6. Ensure that you sign in the examination attendance register before leaving the examination room

SECTION A: CELLS, CELL DIVISION AND MICROBIOLOGY

A1. Jane and Jonathan were medical students at the Lusaka Apex Medical University. After they completed their medical degrees, they decided to get married and have children.

- (a) Given that Jane and Jonathan were both healthy human beings, what was the diploid number of chromosomes they each had in their somatic cells before they got married? [1 Mark]
- (b) What was the haploid number of chromosomes Jane and Jonathan each had in their somatic cells after they got married? [1 Mark]
- (c) By what scientific process did Jonathan's body replace his somatic cells when he fell and injured himself whilst trying out a new rhumba dance during the wedding rehearsals? [1 Mark]
- (d) State the fourth stage of the scientific process you mentioned in (c) above and outline the events that take place in a cell during that phase. [5 Marks].
- (e) Describe the number and type of chromosomes Jane and Jonathan **each** contributed to the somatic cells of their little daughter Jenise who was born a year later. [1 Mark]
- (f) After some weeks, it was suspected that Jenise (the baby) had a rare genetic condition. What scientific method could have been used to quickly detect any abnormality in Jenise's chromosomes? [1 Mark]

A2. Using a well labelled illustration, outline the process of Spermatogenesis in a 70 year old human male. [10 marks]

A3. State the function of the following cellular organelles: (a) Ribosomes (b) Golgi Apparatus (c) Nucleus (d) Mitochondria (e) Kinetochore (f) centrioles (g) centrosomes (h) centromeres (i) cytoskeleton (j) smooth endoplasmic reticulum [10 Marks]

A4. Bacteria are single-celled microorganisms that can be found in a wide range of environments on Earth, including soil, water, air, and living organisms. They are among the oldest and most abundant life forms on the planet, with an incredible diversity of shapes, sizes, and metabolic pathways. Some bacteria are beneficial to human health, while others can cause serious infections and diseases.

- (a) What process do bacteria use to reproduce? [1 Mark]
- (b) Outline the steps of the process you mentioned in (a) above. [5 Marks]
- (c) State any two advantages of the reproductive process you mentioned in (a) above compared to how humans reproduce. [2 Marks]
- (d) State any one disadvantage of the reproductive process you mentioned in (a) above.
[1 Mark]
- (e) What class of drugs are primarily used to control bacterial infections in human beings?
[1 Mark]

A5. Identify the following [5Marks].

- a) Single-celled non-nucleated microorganisms_____.
- b) _____ Large, single-celled nucleated microorganisms.
- c) _____ Photosynthetic large cells that rarely cause human disease.
- d) Branch of Systematics concerned with classification, identification and nomenclature of organisms _____.
- e) _____ are infectious microorganisms that lack nucleic acid.

A6. What do you call the study of the following organisms? [5 Marks]

- a) Algae_____
- b) Fungi_____
- c) Viruses_____
- d) Bacteria_____
- e) Worms_____

SECTION B: BIOMOLECULES

B1. Nucleic acids are biological macromolecules that play a fundamental role in the storage and transmission of genetic information. They are found in all living cells and are responsible for the hereditary traits that are passed down from one generation to the next. There are two main types of nucleic acids: deoxyribonucleic acid (DNA) and ribonucleic acid (RNA), each with distinct structural and functional properties.

- (a) Use an illustration to demonstrate the general structure of a single nucleotide that makes up DNA. [1 Mark]
- (b) State any two **structural** differences between DNA and RNA. [2 Marks]
- (c) Briefly explain the relationship between the sequence of nucleotides that make up nucleic acids and the physical traits that an organism may possess. [1 Mark]
- (d) Write the corresponding complementary base sequence for the following strand of DNA: A-G-T-C-C-A-A-G-G-T [1 Mark]

B2. Water is a vital substance for all life on Earth, and it is essential for many chemical and physical processes that occur in our environment.

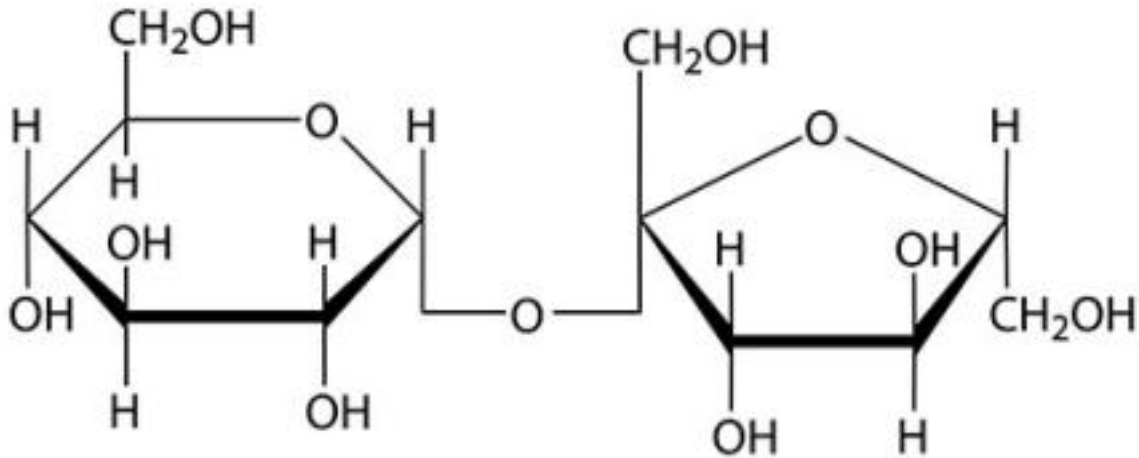
- (a) Explain why the water molecule is V-shaped and not linear. [1 Mark]
- (b) Define the term surface tension and explain how it arises in water. [1 Mark]
- (c) State the biological importance of water having a high heat of vaporization. [1 Mark]
- (d) Which two properties of water contribute to uptake of water from the roots to the leaves via capillary action. [2 Marks]

B3. State the type of enzyme inhibition exhibited in each of the following scenarios **and** whether or not it is reversible or irreversible.

- (a) An enzyme stops working due to excessively high temperatures. [2 Marks]
- (b) An enzyme stops working because an inhibitor that has a structure similar to the substrate binds to the active site of the enzyme. [2 Marks]
- (c) An enzyme stops working because an inhibitor binds to its allosteric site. [2 Marks]
- (d) An enzyme stops working because an inhibitor binds to the enzyme-substrate complex. [2 Marks]

- (e) An enzyme stops working because an inhibitor binds to the R-groups on the active site with strong covalent bonds. [2 Marks]

B4. (a) Refer to the figure below to answer the following questions:



- What is the name of the disaccharide above? [1mark]
 - Name the products formed by the hydrolysis of the disaccharide above.
[1 Mark]
 - State the source of the disaccharide above [1 Mark]
 - What laboratory test can be used to identify the above disaccharide? [1 Mark]
- (b) Compare and contrast the following carbohydrates in terms of structure and function
- Chitin and cellulose [2 Marks]
 - Starch and Glycogen [2 Marks]
- (c) In the absence of carbohydrates, what alternative energy source does the human body use? [2 Marks]

B5. What are the functions of the following proteins? [5 Marks]

- Fibroin
- Keratin
- Ovalbumin
- Actin
- Myoglobin

B6. Waxes are a type of lipid that have a wide range of functions in the natural world. Waxes are

found in a variety of organisms, including plants, animals, and microorganisms.

- (a) In what category of lipids are waxes classified? [2 Marks]
- (b) What is the general composition of a wax? [2 Marks]
- (c) State two functions of waxes in plants. [2 Marks]
- (d) State two functions of waxes in animals [2 Marks]
- (e) State two medical uses of waxes. [2 Marks]

B7. Complete the following table in your answer booklet. [5 Marks]

Vitamin	Scientific Name	Function
A		
B9		
E		
C		
B1		

Total Marks=100