



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES**

**DEPARTMENT CLINICAL OF HEALTH SCIENCES**

<b>QUALIFICATION : BACHELOR OF MEDICAL LABORATORY SCIENCES</b>	
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<b>DURATION:</b> 3 HOURS	<b>MARKS:</b> 122

<b>FIRST OPPORTUNITY EXAMINATION PAPER</b>	
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<b>INSTRUCTIONS</b>
ANSWER ALL THE QUESTIONS.

<b>PERMISSIBLE MATERIALS</b>
CALCULATOR

**THIS QUESTION PAPER CONSISTS OF 7 PAGES (INCLUDING THIS FRONT PAGE)**

**SECTION A****(30)****QUESTION 1****[20]**

Assess the following statements and decide which answer is correct. Write only the number of the question and the correct letter next to it.

- 1.1. According to the cell theory: (1)
- A. All cells have a nucleus.
  - B. All cells are derived from the division of preexisting cells.
  - C. Viruses are considered the simplest form of life.
  - D. All cells are motile.
- 1.2. Which of the following organelles is not part of the endomembrane system? (1)
- A. Endoplasmic reticulum
  - B. Golgi apparatus
  - C. Mitochondrion
  - D. Lysosome
- 1.3. The primary function of the mitochondrion is: (1)
- A. Photosynthesis
  - B. Protein synthesis
  - C. Cellular respiration and ATP production
  - D. Storage of genetic information
- 1.4. Vesicular transport involves the movement of materials in: (1)
- A. Cytoskeletal filaments
  - B. Membrane-enclosed transport vesicles
  - C. Aqueous pores in the membrane
  - D. The cytosol as soluble proteins
- 1.5. The process by which a cell engulfs a large particle, such as a bacterium, is called: (1)
- A. Pinocytosis
  - B. Exocytosis
  - C. Phagocytosis
  - D. Receptor-mediated endocytosis

- 1.6. A protein destined for the lumen of the endoplasmic reticulum (ER) typically has: (1)
- A. A nuclear localisation signal
  - B. An ER signal sequence at its N-terminus
  - C. A mannose-6-phosphate tag
  - D. A KDEL sequence
- 1.7. The addition of oligosaccharide chains to proteins occurs primarily in the: (1)
- A. Cytosol and Nucleus
  - B. Mitochondria and Chloroplasts
  - C. Endoplasmic reticulum and Golgi apparatus
  - D. Lysosomes and Peroxisomes
- 1.8. The lipid bilayer is primarily held together by: (1)
- A. Covalent bonds between lipid tails
  - B. Hydrophobic interactions
  - C. Ionic bonds with water
  - D. Hydrogen bonds between phospholipid heads
- 1.9. Which type of membrane protein is embedded within the lipid bilayer? (1)
- A. Peripheral membrane protein
  - B. Lipid-anchored protein
  - C. Integral membrane protein
  - D. Extracellular matrix protein
- 1.10. Passive transport across a membrane: (1)
- A. Requires energy from ATP hydrolysis.
  - B. Moves solutes against their electrochemical gradient.
  - C. Includes simple diffusion and facilitates diffusion.
  - D. Is carried out only by channel proteins.
- 1.11. The Na<sup>+</sup>/K<sup>+</sup> pump is an example of: (1)
- A. Passive transport
  - B. Active transport
  - C. Ligand-gated channel activity
  - D. Osmosis

- 1.12. Nuclear pore complexes allow for the transport of molecules between the cytoplasm and nucleus. This transport is unique because: (1)
- A. It requires the protein to be completely unfolded.
  - B. It can actively transport large, fully assembled proteins.
  - C. It occurs through simple diffusion for all molecules.
  - D. It is mediated by vesicles budding from the nuclear envelope.
- 1.13. The first step in a signal transduction pathway is typically: (1)
- A. The hydrolysis of ATP.
  - B. The binding of a ligand to its receptor.
  - C. The activation of a transcription factor.
  - D. The phosphorylation of a target protein.
- 1.14. G-protein-coupled receptors (GPCRS) function by: (1)
- A. Directly phosphorylating intracellular proteins.
  - B. Forming a pore for ions to pass through upon ligand binding.
  - C. Activating an associated g-protein subunit upon ligand binding.
  - D. Directly entering the nucleus to regulate gene expression.
- 1.15. Cadherins are a class of cell adhesion molecules that mediate: (1)
- A. Cell-to-matrix adhesion in a calcium-independent manner.
  - B. Tight junctions that seal the space between cells.
  - C. Calcium-dependent adhesion between cells of the same type.
  - D. Transient adhesion of white blood cells to blood vessel walls.
- 1.16. The phase of the cell cycle where DNA replication occurs is: (1)
- A. G1 phase
  - B. S phase
  - C. G2 phase
  - D. M phase
- 1.17. The key regulators of the cell cycle that must be complexed with cyclins to become active are: (1)
- A. Proteases
  - B. Cyclin-dependent kinases (CDKS)
  - C. Phosphatases
  - D. Transcription factors

- 1.18. In the Watson and Crick model of DNA, the two polynucleotide chains are: (1)
- A. Parallel and identical in sequence.
  - B. Antiparallel and complementary in sequence.
  - C. Held together by covalent bonds between bases.
  - D. Composed of a sugar-phosphate backbone on the inside.
- 1.19. The enzyme that synthesises the RNA primer required for DNA replication is: (1)
- A. DNA polymerase
  - B. Primase
  - C. Helicase
  - D. Ligase
- 1.20. Apoptosis, or programmed cell death: (1)
- A. Is always a pathological process.
  - B. Causes inflammation and damage to surrounding tissues.
  - C. Is an orderly process important for normal development and tissue homeostasis.
  - D. Is characterised by cell swelling and rupture.

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**QUESTION 2****[10]**

Assess the following statements and decide whether they are **TRUE OR FALSE**. Write only the number of the question and next to it **TRUE or FALSE** for each statement.

- 2.1. Lysosomes contain powerful hydrolytic enzymes that function best at acidic pH. (1)
- 2.2. Exocytosis involves the fusion of vesicles with the plasma membrane to secrete substances out of the cell. (1)
- 2.3. A protein with a hydrophobic stop-transfer sequence will remain as a transmembrane protein in the ER. (1)
- 2.4. N-linked glycosylation involves the attachment of sugar groups to the amino group of asparagine residues in proteins. (1)
- 2.5. The fluidity of a lipid bilayer decreases with an increase in the proportion of unsaturated fatty acid tails. (1)

- 2.6. Ion-channel-coupled receptors are the slowest type of receptor in transmitting a signal. (1)
- 2.7. Integrins are cell adhesion molecules that primarily link the cytoskeleton to the extracellular matrix. (1)
- 2.8. During mitosis, the nuclear envelope remains intact to protect the chromosomes. (1)
- 2.9. DNA replication is described as semiconservative because each new DNA molecule contains one old strand and one new strand. (1)
- 2.10. Transcription is the process where a sequence of DNA is copied into a complementary sequence of RNA. (1)

**SECTION B (43)****QUESTION 3 [43]**

- 3.1. List any FIVE organelles found in a typical eukaryotic cell and state one primary function for each. (5)
- 3.2. Compare and contrast endocytosis and exocytosis. (6)
- 3.3. Describe the role of the Signal Recognition Particle (SRP) in co-translational protein import into the ER. (6)
- 3.4. Explain the difference between passive transport and active transport across a cell membrane, providing one example of each. (5)
- 3.5. Using an example, briefly describe how a G-protein-coupled receptor (GPCR) can activate an intracellular signalling pathway. (5)
- 3.6. Name the five phases of mitosis in order and describe one key event that occurs in each phase. (10)
- 3.7. Differentiate between the leading strand and the lagging strand in DNA replication. (6)

**SECTION D****(47)****QUESTION 4****[47]**

Instructions: Answer the following questions in detail. Use diagrams where appropriate to support your answer.

**4.1. The Endomembrane System**

- 4.1.1 Explain the structural and functional relationships between the endoplasmic reticulum (ER) and the Golgi apparatus (4)
- 4.1.2 Describe the pathway and mechanisms a soluble protein would take from its synthesis on the rough ER to its secretion from the cell via exocytosis. (7)

**4.2. From DNA to Protein**

Describe the process of gene expression, from the DNA sequence to a functional protein.

- 4.2.1 Outline the key steps of transcription, including the enzyme responsible. (8)
- 4.2.2 Outline the key steps of translation, including the roles of mRNA, tRNA, and ribosomes. (10)
- 4.2.3 Explain one way in which gene expression can be regulated after transcription. (6)

**4.3. Cell Cycle and Cancer**

- 4.3.1 Explain how apoptosis is a normal and essential biological process. (4)
- 4.3.2 Discuss how a failure in the control mechanisms of the cell cycle (e.g., mutations in genes that regulate cell division) can lead to the uncontrolled cell growth characteristic of cancer (8)

**END OF EXAMINATION**

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