THE UNINTED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION AND CULTURE

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

133/1 **BIOLOGY 1**

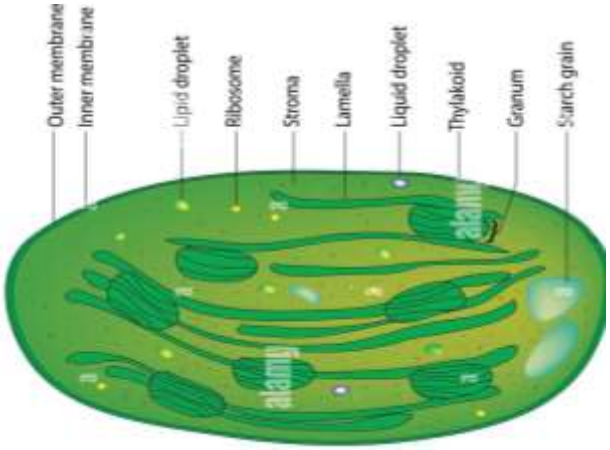
Time: 2:30 Hours **ANSWERS** **Year: 2016.**

Instructios:

1. this paper consists of eleven questions
2. answer all questions in section A, and three questions in section B.
3. the marks allocation is indicated at the beginning of each section.

a1. (a) Draw a structure of chloroplast and label any six parts.
A chloroplast is a double-membrane-bound organelle found in plant cells and certain algae, responsible for photosynthesis. Its structure is highly specialized to capture light energy and convert it into chemical energy.

The chloroplast structure includes
i. Outer membrane
ii. Inner membrane
iii. Stroma
iv. Thylakoids
v. Grana
vi. Lamellae



This diagram illustrates the following key components of a chloroplast:

- Outer membrane is the smooth outermost layer that encloses the chloroplast, serving as a protective barrier and regulating the movement of materials into and out of the organelle.
- Inner membrane is located just beneath the outer membrane, it also regulates the passage of substances and contains transport proteins.
- Intermembrane space is the narrow space between the outer and inner membranes.
- Stroma is the fluid-filled matrix within the inner membrane, containing enzymes, ribosomes, and chloroplast DNA. It is the site of the Calvin cycle, where carbon dioxide is fixed into organic molecules.
- Thylakoids are flattened, disc-like structures arranged in stacks called grana. The thylakoid membranes contain chlorophyll and other pigments that capture light energy for the light-dependent reactions of photosynthesis.
- Granum (plural: grana) is a stack of thylakoids, increasing the surface area for light absorption and enhancing the efficiency of photosynthesis.

(b) State three structural adaptations shown by the chloroplast to its role.

Chloroplasts are adapted to photosynthesis through the following features:
i. Presence of thylakoid membranes: These membranes contain chlorophyll and other pigments necessary for capturing light energy.
ii. Grana arrangement: Thylakoids are stacked into grana to increase surface area for light absorption and ATP generation.
iii. Stroma composition: The stroma contains enzymes essential for the Calvin cycle, enabling carbon fixation.

2. Study the molecular formula below and answer questions that follow:
(a) (i) What is the general name given to the molecular formula above?
The molecular formula represents an amino acid.

(ii) What is the simplest form of R?
The simplest form of R is hydrogen (H), which corresponds to the amino acid glycine.

(b) State six properties of enzymes.

i. Specificity: Enzymes are highly specific to their substrates, forming enzyme-substrate complexes.
ii. Catalytic efficiency: They increase the rate of biochemical reactions without being consumed.
iii. Optimum temperature and pH: Each enzyme functions best at a specific temperature and pH.
iv. Denaturation: Enzymes lose their functionality when exposed to extreme temperatures or pH.
v. Reusability: Enzymes are not consumed in reactions and can be used repeatedly.
vi. Sensitivity to inhibitors: Enzymes can be regulated or inhibited by specific molecules, affecting their activity.

3. (a) Discuss the effect of temperature on the rate of enzymic controlled reaction.

Temperature affects enzyme activity significantly. At low temperatures, enzymes have reduced kinetic energy, resulting in slower reaction rates. As temperature increases, enzyme activity also increases due to more frequent collisions between enzymes and substrates. However, at very high temperatures, enzymes become denatured as their three-dimensional structure is disrupted, rendering them non-functional.

(b) Draw the structure of ATP molecule and explain how it is formed.

ATP (adenosine triphosphate) consists of:
i. A ribose sugar
ii. An adenine base
iii. Three phosphate groups

ATP is formed through cellular respiration or photosynthesis. Energy is stored in the high-energy phosphate bonds and is released when ATP is hydrolyzed into ADP and Pi (inorganic phosphate).

4. (a) (i) Define the term taxonomic hierarchy.

Taxonomic hierarchy is the systematic classification of living organisms into hierarchical levels based on shared characteristics, starting from the broadest (kingdom) to the most specific (species).

(ii) Using man as an example, illustrate the concept of taxonomic hierarchy.

i. Kingdom: Animalia
ii. Phylum: Chordata
iii. Class: Mammalia
iv. Order: Primates
v. Family: Hominidae
vi. Genus: Homo
vii. Species: Homo sapiens

(b) Explain four advantages of using artificial system of classification.

i. Simplicity: Artificial systems classify organisms based on observable traits, making them easy to use.
ii. Ease of comparison: Traits like flower color or leaf shape can be compared easily between species.
iii. Practical application: Useful for identifying plants or animals for agriculture or horticulture.
iv. Quick identification: Organisms can be identified without requiring in-depth knowledge of genetics or evolutionary history.

5. (a) State three similarities between respiration and photosynthesis.
i. Both involve the exchange of gases, with oxygen and carbon dioxide playing key roles.
ii. Both processes occur in specific organelles: mitochondria for respiration and chloroplasts for photosynthesis.
iii. Both rely on electron transport chains to produce ATP.

(b) What will happen to the rate of respiration if:

(i) Temperature is raised above optimal point?
The rate of respiration will initially increase but will eventually decrease as enzymes become denatured at high temperatures, halting the reaction.
(ii) Health of an organism is impaired?
Respiration rates may decline due to reduced metabolic activity or damage to respiratory enzymes, leading to less energy production and impaired cellular functions.

6. (a) (i) Which solution has higher water potential?

Solution M has higher water potential because it has a lower concentration of solutes compared to Solution N, meaning it has more free water molecules available for movement.

(ii) Which solution has higher solute potential?

Solution N has higher solute potential because it contains a higher concentration of solute molecules, reducing its water potential.

(iii) In which direction will osmosis occur?

Osmosis will occur from Solution M to Solution N. Water molecules move from the region of higher water potential (Solution M) to the region of lower water potential (Solution N) through the partially permeable membrane.

(b) State four roles of osmosis in living organisms.

i. Osmosis helps in the absorption of water by plant roots from the soil, which is essential for growth and metabolic processes.
ii. It maintains turgidity in plant cells, providing mechanical support to non-woody parts of plants.
iii. Osmosis regulates the movement of water in and out of cells, helping maintain cell shape and preventing cell bursting or shrinking.
iv. It plays a role in kidney function in animals, where water is reabsorbed into the bloodstream to maintain fluid balance.

7. (a) Give five differences between mitosis and meiosis.

i. Mitosis occurs in somatic cells, while meiosis occurs in germ cells.
ii. Mitosis produces two identical daughter cells, while meiosis produces four genetically different haploid cells.
iii. Mitosis involves one division, while meiosis involves two divisions (meiosis I and meiosis II).
iv. Mitosis maintains the chromosome number of the parent cell, whereas meiosis reduces the chromosome number by half.
v. Crossing over occurs in meiosis, leading to genetic variation, while it does not occur in mitosis.

(b) State two significances of meiosis process in sexual reproducing organisms.

i. Meiosis produces haploid gametes, ensuring the maintenance of a stable chromosome number in offspring during fertilization.
ii. It introduces genetic variation through crossing over and independent assortment, which is crucial for evolution and adaptability.

8. (a) describe the movement of water and mineral salts across the root through the following ways:

(i) Symplast
The symplast pathway involves the movement of water and solutes through the cytoplasm of plant cells. Water enters the root hair cell and passes from cell to cell through plasmodesmata, which connect the cytoplasm of adjacent cells.

(ii) Vacuolar
The vacuolar pathway involves the movement of water through the vacuoles of plant cells. Water enters the root hair cell and moves from one vacuole to another by crossing the tonoplast membrane, passing through the cytoplasm between cells.

(iii) Apoplast
The apoplast pathway involves the movement of water through the cell walls and intercellular spaces. Water does not enter the cytoplasm or vacuoles but moves freely along the hydrophilic walls until it reaches the endodermis, where the Casparian strip forces it into the symplast pathway.

(b) Explain five roles of water in plants.

i. Water is a reactant in photosynthesis, providing the hydrogen needed to produce glucose.
ii. It acts as a solvent, dissolving nutrients and facilitating their transport through the xylem and phloem.
iii. Water maintains turgidity in plant cells, supporting the structure of leaves and stems.
iv. It regulates temperature through transpiration, which cools the plant.
v. Water helps in seed germination by activating enzymes and softening the seed coat for growth.

9. (a) (i) Identify the cell.

The cell shown in Figure 2 is a bacterial cell (prokaryotic cell).

(ii) Name the parts labeled A, B, C, D, E, F, and G.

A: Flagellum
B: Capsule
C: Cell wall
D: Plasma membrane
E: Cytoplasm
F: Ribosomes
G: Nucleoid (genetic material)

(b) Outline five differences between the cell in 9(a) above and a trypanosome cell.

i. The bacterial cell is prokaryotic, while the trypanosome cell is eukaryotic.
ii. The bacterial cell lacks membrane-bound organelles, whereas the trypanosome cell has organelles such as a nucleus and mitochondria.
iii. The genetic material in the bacterial cell is not enclosed within a nucleus, while in the trypanosome cell, it is enclosed within a nuclear membrane.
iv. The bacterial cell has a rigid cell wall, whereas the trypanosome cell lacks a cell wall and instead has a flexible pellicle.
v. The bacterial cell reproduces by binary fission, while the trypanosome cell reproduces by mitosis and cytokinesis.

10. describe how the structure of cardiac muscles is adapted to its function.

Cardiac muscle tissue, found exclusively in the heart, is uniquely structured to support its continuous and rhythmic contractions essential for pumping blood throughout the body. Its specialized features enable both strength and endurance, ensuring efficient cardiac function.

i. Branched fibers. Unlike the linear arrangement in skeletal muscles, cardiac muscle fibers are branched, allowing for the rapid transmission of electrical impulses in multiple directions. This branching facilitates synchronized contractions across the heart muscle, ensuring efficient blood pumping.
ii. Intercalated discs. These specialized junctions connect adjacent cardiac cells, containing gap junctions and desmosomes. Gap junctions permit direct electrical communication between cells, enabling the heart to function as a unified entity. Desmosomes provide mechanical strength, preventing cells from separating during forceful contractions.

iii. Striations. Similar to skeletal muscle, cardiac muscle exhibits a striated appearance due to the organized arrangement of actin and myosin filaments. This striation reflects the presence of sarcomeres, the fundamental contractile units, which contribute to the muscle's ability to contract efficiently.

iv. Central nuclei. Cardiac muscle cells typically contain a single, centrally located nucleus, optimizing the distribution of genetic material and supporting cellular function.

v. Abundant mitochondria. High mitochondrial density within cardiac cells ensures a continuous supply of adenosine triphosphate (ATP), meeting the substantial energy demands required for persistent heart contractions.

vi. Involuntary control. Regulated by the autonomic nervous system, cardiac muscle operates without conscious effort, maintaining the heart's rhythmic activity essential for life.

These structural adaptations collectively enable cardiac muscle to perform its vital role in circulatory physiology, combining durability with the capacity for sustained, rhythmic contractions.

11. (a) Name the chemical composition of proteins.

Proteins are composed of carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur. They are made up of amino acids linked together by peptide bonds to form polypeptide chains.

(b) Explain six categories of protein based on their functions.

i. Structural proteins: Provide support and shape to cells and tissues, such as collagen in connective tissue and keratin in hair and nails.
ii. Enzymatic proteins: Act as catalysts in biochemical reactions, such as amylase, which breaks down starch into sugars.

iii. Transport proteins: Facilitate the transport of molecules, such as hemoglobin, which carries oxygen in the blood.
iv. Defensive proteins: Protect the body against pathogens, such as antibodies produced by the immune system.
v. Regulatory proteins: Regulate cellular processes, such as insulin, which controls blood sugar levels.
vi. Contractile proteins: Facilitate movement, such as actin and myosin in muscle contraction.