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: 2014.**

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.

1. (a) Briefly explain the functions of the vascular system in plants.

The vascular system in plants consists of xylem and phloem tissues that perform the following functions:
i. The xylem transports water and dissolved minerals from the roots to the leaves, supporting photosynthesis and other metabolic processes.
ii. The phloem distributes organic nutrients, such as sugars produced during photosynthesis, from the leaves to other parts of the plant for storage or immediate use.
iii. The vascular system provides structural support to the plant, maintaining its upright posture.

(b) Explain the processes involved in transportation of water from the soil to the xylem.

The transportation of water involves three main processes:
i. Osmosis. Water is absorbed by root hair cells from the soil due to the higher water potential in the soil compared to the root cells.
ii. Apoplast and symplast pathways. Water moves through the cell walls (apoplast) or cytoplasm (symplast) of root cells until it reaches the endodermis.
iii. Root pressure and transpiration pull. Water enters the xylem through active transport and is pulled upward by cohesion and adhesion forces during transpiration.

2. (a) Define the following terms:
(i) Photoautotrophs. Organisms that produce their own food using light energy, carbon dioxide, and water, such as plants and algae.
(ii) Chemoheterotrophs. Organisms that obtain energy by consuming organic compounds, such as animals and fungi.

(b) What would be the effect of lowering oxygen concentration on the following:
(i) C3 photosynthesis. Lower oxygen concentration reduces photorespiration, enhancing photosynthetic efficiency and glucose production.
(ii) C4 photosynthesis. C4 plants are less affected due to their adaptation of concentrating CO2 around RuBisCO, which minimizes photorespiration.

(c) (i) Why is it an advantage that bundle sheath chloroplasts lack grana?
The lack of grana in bundle sheath chloroplasts reduces photorespiration, allowing these cells to focus on the Calvin cycle for efficient carbon fixation.

(ii) What would happen to the activities of intestinal enzymes if the pH in the intestine remains at 2?
The activity of intestinal enzymes would be inhibited because they function optimally at a neutral or slightly alkaline pH, leading to reduced digestion and nutrient absorption.

3. (a) What is glycolysis?

Glycolysis is the metabolic pathway that breaks down glucose into pyruvate, producing ATP and NADH in the cytoplasm of cells.

(b) In what ways are fermentation processes useful to human beings?

i. Fermentation is used in the production of alcoholic beverages such as beer and wine.
ii. It is utilized in the food industry for making bread, yogurt, and cheese.
iii. Fermentation is applied in the pharmaceutical industry to produce antibiotics and other drugs.
iv. It allows for energy production in cells under anaerobic conditions, such as during vigorous exercise.

4. (a) Account for the birth of the following babies:
(i) Identical twins. Result from the splitting of a single fertilized egg into two embryos with identical genetic material.
(ii) Fraternal twins. Result from the fertilization of two separate eggs by two separate sperm cells, producing genetically different siblings.
(iii) Conjoined twins. Result from the incomplete separation of identical twins during early embryonic development.

(b) Outline one feature for each of the births in 4(a) above.
i. Identical twins share the same genetic material and are always of the same sex.
ii. Fraternal twins have different genetic material and can be of the same or different sexes.
iii. Conjoined twins are physically attached and may share organs or body parts.

5. (a) By using examples classify cells into two major groups. Give four features for each group to justify your answers.

Cells are classified into prokaryotic (e.g., bacteria) and eukaryotic (e.g., plant and animal cells).
i. Prokaryotic cells: Lack a nucleus, have a single circular chromosome, lack membrane-bound organelles, and have a cell wall made of peptidoglycan.
ii. Eukaryotic cells: Have a nucleus, possess multiple linear chromosomes, contain membrane-bound organelles, and are larger in size than prokaryotic cells.

(b) Outline three advantages of the presence of membranes in cell organelles.
i. They compartmentalize cellular functions, allowing different processes to occur simultaneously.
ii. Membranes increase the surface area for biochemical reactions, such as in mitochondria and chloroplasts.
iii. They regulate the movement of substances in and out of organelles, maintaining homeostasis.

6. (a) What do you understand by the term Taxonomic Key as used in Biology?

A taxonomic key is a tool used by biologists to identify and classify organisms based on their physical characteristics. It consists of a series of paired statements or questions that describe contrasting traits of organisms, leading the user to the correct identification of the organism.

(b) Explain how to construct and use a Dichotomous Key.

To construct and use a dichotomous key:
i. Observe and record distinguishing characteristics of the organisms.
ii. Group organisms based on similarities and differences in their traits.
iii. Create paired statements (couplets) that offer two contrasting options at each step.
iv. Test the key for accuracy and revise as needed.
v. Use the key by following the statements step-by-step until the organism is identified.

7. (a) Distinguish nastic movements from tactic movements in living organisms. Give one example in each case.

Nastic movements are non-directional responses to stimuli, while tactic movements are directional responses.
i. Nastic movement. A response that does not depend on the direction of the stimulus, such as the closing of Mimosa pudica leaves when touched.
ii. Tactic movement. A movement toward or away from the stimulus, such as the movement of Euglena towards light (positive phototaxis).

(b) Explain the importance of tropic movement in plants.
Tropic movements are directional growth responses to stimuli, such as light, gravity, and water. They are important because:
i. Phototropism allows plants to grow toward light, maximizing photosynthesis.
ii. Gravitropism ensures that roots grow downward for anchorage and nutrient absorption, while shoots grow upward for exposure to light.
iii. Hydrotropism directs root growth toward water sources, ensuring adequate hydration for survival.

8. (a) Describe the tertiary structure of a protein.

The tertiary structure of a protein refers to the three-dimensional shape formed by the folding of its polypeptide chain. This structure is stabilized by interactions such as hydrogen bonds, ionic bonds, disulfide bridges, and hydrophobic interactions between the side chains (R-groups) of the amino acids. The specific tertiary structure determines the protein's function and its ability to interact with other molecules.

(b) Elaborate six categories of protein basing on their functions.

i. Structural proteins. Provide support and strength to cells and tissues, such as collagen in connective tissues and keratin in hair and nails.
ii. Enzymatic proteins. Act as catalysts to speed up biochemical reactions, such as amylase breaking down starch into sugars.
iii. Transport proteins. Facilitate the movement of substances, such as hemoglobin transporting oxygen in the blood.
iv. Defensive proteins. Protect the organism against pathogens, such as antibodies in the immune system.

v. Hormonal proteins. Regulate physiological processes, such as insulin controlling blood glucose levels.
vi. Contractile proteins. Enable movement by interacting with the cytoskeleton, such as actin and myosin in muscle contraction.

9. Explain the seven roles of synapse.

i. Transmission of impulses. Synapses enable the transfer of electrical signals between neurons and to effector cells.
ii. Directionality. Synapses ensure the one-way flow of information from the presynaptic neuron to the postsynaptic cell.
iii. Signal integration. They allow the summation of multiple signals, determining whether a neuron will fire an action potential.
iv. Signal modulation. Synapses can amplify or inhibit signals through neurotransmitter release.
v. Learning and memory. Synapses are involved in forming neural circuits that underpin learning and memory.
vi. Filtering signals. They help filter weak signals and ensure that only significant stimuli elicit a response.
vii. Coordination. Synapses facilitate communication within neural networks, enabling coordinated responses.

10. (a) Describe the internal structure of the mammalian lung.
The mammalian lung is a complex organ designed to facilitate efficient gas exchange. Its internal structure can be outlined as follows:

(i) Trachea and Bronchi: Air enters through the trachea, which bifurcates into the right and left main bronchi, each leading to a lung. These bronchi further divide into smaller bronchi and bronchioles, forming the bronchial tree.
(ii) Bronchioles: The bronchioles are smaller airways that lack cartilage and lead to the regions where gas exchange occurs. They continue to branch and decrease in size, eventually becoming terminal bronchioles.
(iii) Respiratory Bronchioles and Alveolar Ducts: Terminal bronchioles give rise to respiratory bronchioles, which have alveoli budding from their walls. These lead into alveolar ducts, which are extensively lined with alveoli.

(iv) Alveoli: Alveoli are tiny, balloon-like structures where gas exchange occurs. Each alveolus is surrounded by a network of capillaries, facilitating the exchange of oxygen and carbon dioxide between the air and blood.
(v) Alveolar Cells: The alveoli are lined by two types of cells: Type I pneumocytes, which form the structure of the alveolar walls, and Type II pneumocytes, which secrete surfactant to reduce surface tension and prevent alveolar collapse.
(vi) Blood-Air Barrier: The thin membrane between the alveolar air and the pulmonary capillaries, known as the blood-air barrier, allows for efficient gas diffusion.

(vii) Pleura: Each lung is encased in a double-layered serous membrane called the pleura. The visceral pleura covers the lung surface, while the parietal pleura lines the thoracic cavity. The space between these layers contains pleural fluid, reducing friction during respiration.

(b) Why it is not advisable to warm the room at night by using charcoals while people are sleeping in the house and both door and windows are closed?

Using charcoal for heating in a closed room produces carbon monoxide, a toxic gas that binds to hemoglobin more effectively than oxygen. This prevents oxygen transport in the blood, leading to hypoxia, unconsciousness, or even death.

11. (a) State three disadvantages of a closed as compared to an open circulatory system.

i. A closed circulatory system is more energy-intensive to maintain because of the high pressure required to circulate blood.
ii. It requires a more complex and well-developed heart and blood vessels, increasing the system's vulnerability to failure.
iii. High blood pressure in a closed system can cause damage to delicate capillaries or lead to other cardiovascular issues.

(b) Describe foetal blood circulation in human beings.

Foetal blood circulation bypasses the lungs, as the foetus receives oxygen from the placenta. Blood rich in oxygen and nutrients flows from the placenta through the umbilical vein to the foetus. The ductus venosus directs blood into the inferior vena cava, bypassing the liver. Blood then enters the right atrium, and most of it passes to the left atrium through the foramen ovale, bypassing the lungs. The ductus arteriosus also allows blood to bypass the lungs by connecting the pulmonary artery to the aorta. Blood returns to the placenta via the umbilical arteries for reoxygenation.