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: 2012**

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) State any four functions of lipids in living organisms.

i. Energy storage. Lipids provide a long-term energy source, storing more energy per gram than carbohydrates or proteins.
ii. Insulation. Lipids, particularly in adipose tissue, help insulate the body and maintain temperature.
iii. Protection. Lipids cushion and protect vital organs from physical damage.
iv. Structural role. Lipids are key components of cell membranes, maintaining membrane fluidity and integrity.

(b) Outline four roles of plasma membrane of a cell.

i. Regulation of substance movement. It controls the entry and exit of materials, maintaining homeostasis.
ii. Communication. It contains receptors for cell signaling and interaction with the environment.
iii. Compartmentalization. It separates the cell's internal components from the external environment.
iv. Transport. It facilitates passive and active transport of molecules.

2. (a) Complete Table 1 to indicate the names of the digestive glands located in the wall of the buccal cavity and the stomach, their secretions, and roles.

Name of part of the digestive tract	**Name of the gland**	**Secretion**	**Roles of the secretion**
Buccal cavity	Salivary gland	Saliva	Lubricates food and begins starch digestion (amylase).
Stomach	Gastric gland	Gastric juice	Breaks down proteins (pepsin) and activates enzymes.

(b) State how you can prevent the following disorders of the digestive system.

i. Peptic ulcers. Avoid excessive use of NSAIDs, reduce stress, and treat infections such as H. pylori.
ii. Heartburn. Avoid overeating, maintain a healthy weight, and reduce consumption of acidic or spicy foods.

3. (a) Briefly explain five factors affecting the rate of diffusion across membranes.

i. Concentration gradient. A higher gradient increases diffusion rate.
ii. Temperature. Higher temperatures increase molecular movement, speeding up diffusion.
iii. Surface area. Larger surface areas allow more diffusion.
iv. Membrane thickness. Thinner membranes enhance diffusion efficiency.
v. Molecule size. Smaller molecules diffuse faster than larger ones.

(b) Briefly explain the significance of root pressure.

Root pressure helps drive water and nutrients from the roots to the upper parts of the plant, especially during low transpiration rates. It also aids in the rehydration of xylem tissues.

4. (a) Give four differences between aerobic respiration and anaerobic respiration.

i. Oxygen requirement. Aerobic respiration requires oxygen, while anaerobic does not.
ii. End products. Aerobic produces carbon dioxide and water, while anaerobic produces lactic acid or ethanol.
iii. Energy yield. Aerobic respiration generates more ATP compared to anaerobic respiration.
iv. Location. Aerobic occurs in mitochondria, while anaerobic occurs in the cytoplasm.

(b) The table below shows oxygen consumption and body mass of three resting mammals.

i. Which mammal consumes the largest total volume of oxygen at rest?

Mammal C consumes the largest total volume of oxygen at rest due to its large mass, despite its lower oxygen consumption per gram.

ii. Explain why when both mammals are resting, mammal A requires much more oxygen per hour than mammal C.

Mammal A has a higher metabolic rate, leading to greater oxygen demand per gram of tissue for cellular processes compared to Mammal C.

5. (a) Outline one function for each of the following hormones.

i. Thyroxine. Regulates metabolic rate and growth.
ii. Insulin. Regulates blood glucose levels by promoting glucose uptake by cells.
iii. Gibberellin. Promotes seed germination and stem elongation.
iv. Auxins. Regulate cell elongation and phototropism.

(b) State one function which the following structures have in common.

i. Sclerotic layer and bony labyrinth. Provide protection to internal structures.
ii. Eye lenses and basilar membranes. Focus light and sound waves, respectively.
iii. Rods, cones, and sensory hair cells. Detect sensory stimuli like light and sound.

6. (a) Name the structures labelled A, B, C, D, E, and F.

A. Primary follicle
B. Secondary follicle
C. Graafian follicle
D. Ovum
E. Corpus luteum
F. Corpus albicans

(b) Rearrange and explain the correct development sequence of the structures labelled A, B, D, E, and F.

Correct sequence: A -> B -> C -> D -> E -> F
Explanation. The primary follicle develops into the secondary follicle, which matures into the Graafian follicle. The ovum is released during ovulation, and the remaining structure forms the corpus luteum. If fertilization does not occur, it degenerates into the corpus albicans.

7. (a) What are the reasons leading to a dynamic natural classification?

Natural classification systems are dynamic due to several factors:

(i) Advancements in Scientific Knowledge: As new information emerges about species' genetics, behaviors, and ecological roles, classifications are updated to reflect these insights.

(ii) Discovery of New Species: The identification of previously unknown species necessitates adjustments in existing classification frameworks to accommodate new biodiversity.

(iii) Technological Progress: Innovations in tools and methodologies, such as molecular phylogenetics, provide deeper understanding of evolutionary relationships, prompting reclassification.

(iv) Reevaluation of Evolutionary Relationships: Ongoing research may reveal that certain species are more or less closely related than previously thought, leading to taxonomic revisions.

(b) State the differences between natural and artificial classification systems.

Natural and artificial classification systems differ in several key aspects:

(i) Basis of Classification: Natural classification groups organisms based on evolutionary relationships and genetic similarities, while artificial classification relies on observable traits, such as morphology or habitat.

(ii) Reflecting Evolutionary Relationships: Natural systems aim to depict true phylogenetic relationships, whereas artificial systems do not necessarily represent evolutionary histories.

(iii) Predictive Value: Natural classifications allow for predictions about shared characteristics within groups, enhancing understanding of biology and ecology. In contrast, artificial classifications may not provide such predictive insights.

(iv) Stability and Flexibility: Natural classifications are more flexible, accommodating new discoveries and changes in understanding, while artificial classifications tend to be more rigid and less adaptable.

8. (a) Explain the properties of enzymes.

Enzymes exhibit several fundamental properties:

(i) Catalytic Efficiency: Enzymes significantly accelerate the rate of biochemical reactions, often by factors of millions, enabling vital physiological processes to occur under mild conditions.

(ii) Specificity: Each enzyme typically acts on a specific substrate or a group of closely related substrates, ensuring precise control over metabolic pathways.

(iii) Reversibility: Many enzyme-catalyzed reactions are reversible, allowing the cell to maintain metabolic balance as needed.

(iv) Sensitivity to Environmental Conditions: Enzyme activity is influenced by factors such as temperature, pH, and substrate concentration. Optimal conditions are necessary for maximal activity, and deviations can lead to denaturation or reduced efficiency.

(b) In what way is the knowledge of competitive inhibition important?

Understanding competitive inhibition is crucial for several reasons:

(i) Drug Development: Many pharmaceuticals are designed as competitive inhibitors to modulate enzyme activity associated with diseases. For example, methotrexate acts as a competitive inhibitor in cancer therapy.

(ii) Metabolic Regulation: Competitive inhibition plays a significant role in enzyme regulation and homeostasis within cells. It provides a finely tuned mechanism for controlling the rate of enzymatic reactions in response to changes in substrate availability.

(iii) Toxicology: Some toxins exert their effects through competitive inhibition, and understanding this mechanism can aid in developing antidotes or treatments.

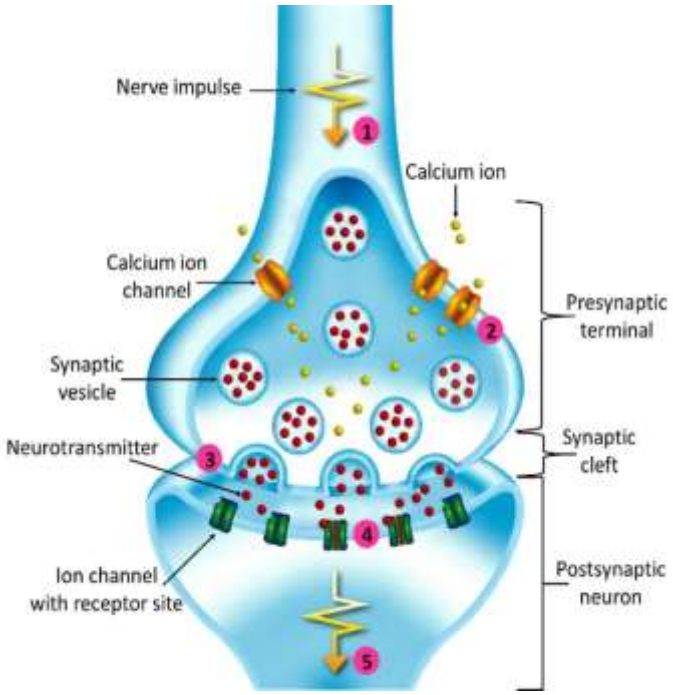
9. With the aid of a diagram, describe the structure of a synapse.

A synapse is the junction between two neurons that facilitates the transmission of nerve impulses. It comprises several key components:

(i) Presynaptic Terminal: Located at the end of the axon of the transmitting neuron, this terminal contains synaptic vesicles filled with neurotransmitters. When an action potential reaches the presynaptic terminal, it triggers the release of these neurotransmitters into the synaptic cleft.

(ii) Synaptic Cleft: This is the small gap, approximately 20 nanometers wide, between the presynaptic and postsynaptic neurons. The synaptic cleft ensures that the transmission of the nerve impulse is unidirectional and allows for the diffusion of neurotransmitters to the postsynaptic membrane.

(iii) Postsynaptic Membrane: Located on the dendrite or cell body of the receiving neuron, the postsynaptic membrane contains specific receptors that bind to the neurotransmitters released into the synaptic cleft. This binding leads to the generation of a new electrical signal in the postsynaptic neuron.



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10. Describe four advantages and three disadvantages of reproduction by seeds.

Advantages:

(i) Genetic Diversity: Seed reproduction promotes genetic variation, leading to hybrids with superior qualities and increased adaptability to environmental changes.

(ii) Long-term Storage: Seeds can be stored for extended periods without losing viability, allowing plants to survive unfavorable conditions and germinate when circumstances improve.

(iii) Disease Resistance: Seed propagation can produce virus-free plants, reducing the risk of disease transmission compared to some vegetative propagation methods.

(iv) Cost-Effectiveness: Raising plants from seeds is generally less expensive and more straightforward than other propagation methods, making it accessible for large-scale cultivation.

Disadvantages:

(i) Genetic Variability: Due to genetic variation, it can be challenging to retain specific superior qualities consistently, leading to unpredictable traits in offspring.

(ii) Longer Maturation Period: Plants grown from seeds may take more time to reach maturity and produce offspring compared to those propagated vegetatively.

(iii) Dormancy and Germination Challenges: Some seeds exhibit long dormancy periods or require special treatments to germinate, complicating the propagation process.

11. Discuss with specific examples the feedback mechanism of hormonal coordination in animals.

Hormonal coordination in animals is primarily regulated through feedback mechanisms, which maintain homeostasis by adjusting hormone levels in response to internal changes. These mechanisms are categorized into negative and positive feedback loops.

Negative Feedback Mechanisms

Negative feedback loops are the most common regulatory mechanisms in endocrine systems. In these loops, a change in a physiological variable triggers a response that counteracts the initial fluctuation, thereby maintaining equilibrium.

A classic example is the regulation of blood glucose levels. After a meal, blood glucose levels rise, prompting the pancreas to secrete insulin. Insulin facilitates the uptake of glucose by cells, reducing blood glucose concentrations. As glucose levels normalize, insulin secretion diminishes, preventing excessive

glucose depletion. Conversely, when blood glucose levels drop, the pancreas releases glucagon, which stimulates the release of glucose into the bloodstream, restoring balance.

Another example is the hypothalamic-pituitary-adrenal (HPA) axis. The hypothalamus secretes corticotropin-releasing hormone (CRH), stimulating the pituitary gland to release adrenocorticotropic hormone (ACTH). ACTH then prompts the adrenal glands to produce cortisol. Elevated cortisol levels inhibit the release of CRH and ACTH, ensuring cortisol concentrations remain within optimal ranges.

Positive Feedback Mechanisms

Positive feedback loops, though less common, amplify physiological changes to drive processes to completion. In these loops, an initial stimulus intensifies the response, leading to a further increase in the original stimulus.

A notable example is the role of oxytocin during childbirth. Uterine contractions push the baby toward the cervix, causing it to stretch. Stretch receptors in the cervix send signals to the brain, prompting the release of oxytocin. Oxytocin enhances uterine contractions, further stretching the cervix and increasing oxytocin release. This cycle continues until delivery occurs.

Another example is the process of blood clotting. When a blood vessel is damaged, platelets adhere to the injury site and release chemicals that attract more platelets. This accumulation continues rapidly until a clot forms, effectively sealing the wound.

These feedback mechanisms are essential for maintaining physiological stability and ensuring appropriate responses to internal and external stimuli in animals.