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: 2009.**

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) Define a taxonomic key.

A taxonomic key is a tool used by biologists to identify and classify organisms based on observable characteristics. It consists of a series of statements or questions that lead to the identification of a species.

(b) In what ways is scientific naming of organisms important?

i. Universal communication: Scientific names are recognized globally, avoiding confusion caused by local names.
ii. Reflect evolutionary relationships: The naming system reflects the organism's phylogeny and taxonomy.
iii. Consistency: It provides a standard method for identifying and categorizing organisms.
iv. Research and conservation: It facilitates scientific research and efforts to protect species.
v. Avoids redundancy: Prevents multiple names for the same organism.

2. (a) What is the significance of classifying organisms?

Classification helps in organizing and simplifying the vast diversity of life forms, aiding in their study, comparison, and understanding of evolutionary relationships.

(b) Outline the merits and demerits of using a common name for identifying a living organism.

Merits:
i. Easy to remember: Common names are familiar and often descriptive.
ii. Locally relevant: Common names are specific to a region or language.

Demerits:
i. Lack of standardization: The same species may have different names in different regions.
ii. Ambiguity: Different species may share the same common name.
iii. No evolutionary information: Common names do not reflect phylogenetic relationships.

3. (a) Explain the roles of:

(i) Ribulose diphosphate: It is a five-carbon sugar that acts as a carbon dioxide acceptor in the Calvin cycle of photosynthesis, enabling the formation of two molecules of 3-phosphoglycerate.

(ii) NADP in photosynthesis: It acts as an electron carrier, getting reduced to NADPH during the light-dependent reactions, which is then used in the Calvin cycle to fix carbon.

(b) (i) Why is photorespiration more common in C3 plants than C4 plants?

C3 plants lack mechanisms to concentrate CO_2 in the chloroplasts, leading to oxygenation of ribulose diphosphate by rubisco, especially under high temperatures or low CO_2 levels.

(ii) Why are C4 plants more efficient in photosynthesizing than C3 plants?

C4 plants use a CO2 concentrating mechanism, minimizing photorespiration and allowing them to thrive in hot, dry environments.

4. (a) How does the electron transport chain system release ATP molecules?

The electron transport chain creates a proton gradient across the inner mitochondrial membrane. As protons flow back through ATP synthase, the enzyme synthesizes ATP from ADP and inorganic phosphate.

(b) Explain why the electron transport systems are important in living organisms.

i. Energy production: It is the primary source of ATP in aerobic organisms.
ii. Drives metabolic processes: Provides energy for cellular processes like synthesis and active transport.

5. Explain the roles of the mammalian hypothalamus in temperature regulation.

i. Detects temperature changes: The hypothalamus has thermoreceptors to monitor internal and external temperatures.
ii. Initiates responses: Activates mechanisms such as sweating or shivering to maintain homeostasis.
iii. Regulates hormones: Controls the release of hormones like thyroxine to modulate metabolic heat production.

6. Define the following genetical terms:

(i) Genotype: The genetic makeup of an organism, representing its inherited alleles.
(ii) Phenotype: The observable traits or characteristics of an organism, influenced by its genotype and environment.
(iii) Homozygous: Having two identical alleles for a particular gene.
(iv) Heterozygous: Having two different alleles for a particular gene.

7. Explain the process of natural selection in relation to:

(a) Peppered moth:
The phenomenon of the peppered moth is a classic example of natural selection. Before industrialization in England, light-colored peppered moths were more common because they blended in with the lichen-covered trees, avoiding predators. However, during industrialization, soot darkened the trees, favoring the survival of dark-colored moths, which were now better camouflaged. Over time, the dark-colored variant increased in frequency, demonstrating how environmental changes drive natural selection.

(b) Bacterial resistance to antibiotics:
Bacteria exposed to antibiotics exhibit natural selection. When an antibiotic is introduced, most bacteria die, but those with mutations that confer resistance survive and reproduce. Over successive generations, the resistant bacteria dominate the population, rendering the antibiotic ineffective. This highlights the role of selective pressure in the evolution of resistance traits.

8. (a) Explain briefly the following:

(i) Ecological succession:
Ecological succession is the gradual process by which ecosystems undergo changes in species composition and structure over time. It occurs in stages, beginning with pioneer species colonizing a barren area, followed by intermediate species, and culminating in a stable climax community.

(ii) Ecological niche:
An ecological niche refers to the role or position a species occupies in its ecosystem, including its interactions with other species and its environment. It encompasses the species' habitat, diet, and behavior, contributing to ecosystem balance.

(b) Describe the possible damages that result from absorption of smoke and fumes from factories and motor vehicles into rainwater.

i. Acid rain formation: Smoke and fumes release sulfur dioxide and nitrogen oxides, which react with water in the atmosphere to form acidic compounds, leading to acid rain.
ii. Soil degradation: Acid rain lowers soil pH, harming plant growth and reducing agricultural productivity.
iii. Water pollution: Acid rain contaminates water bodies, affecting aquatic life and reducing water quality.
iv. Structural damage: Acidic precipitation corrodes buildings, monuments, and infrastructure.
v. Respiratory issues: Pollutants from smoke and fumes can exacerbate respiratory diseases in humans.

9. (a) Study the diagram and answer the questions which follow:

(i) Name the structures labeled A to E:
A – Phosphate group
B – Sugar (deoxyribose)
C – Adenine
D – Thymine
E – Hydrogen bond

(b) Compare DNA and RNA structures on basis of sugars, bases, strands, and helices:

i. Sugars: DNA contains deoxyribose, while RNA contains ribose.
ii. Bases: DNA includes thymine, while RNA has uracil in place of thymine.
iii. Strands: DNA is double-stranded, whereas RNA is single-stranded.
iv. Helices: DNA forms a double helix, while RNA usually remains linear or forms secondary structures.

10. (a) Define speciation:
Speciation is the evolutionary process by which populations of a single species diverge into distinct species due to genetic isolation and evolutionary pressures.

(b) Explain how geographical isolation may bring about speciation:
Geographical isolation separates populations of a species, preventing interbreeding. Over time, genetic differences accumulate due to mutations, natural selection, and genetic drift, eventually leading to reproductive isolation and the emergence of new species.

11. (a) By means of labeled diagrams only, show the differences between motor and sensory neurons.
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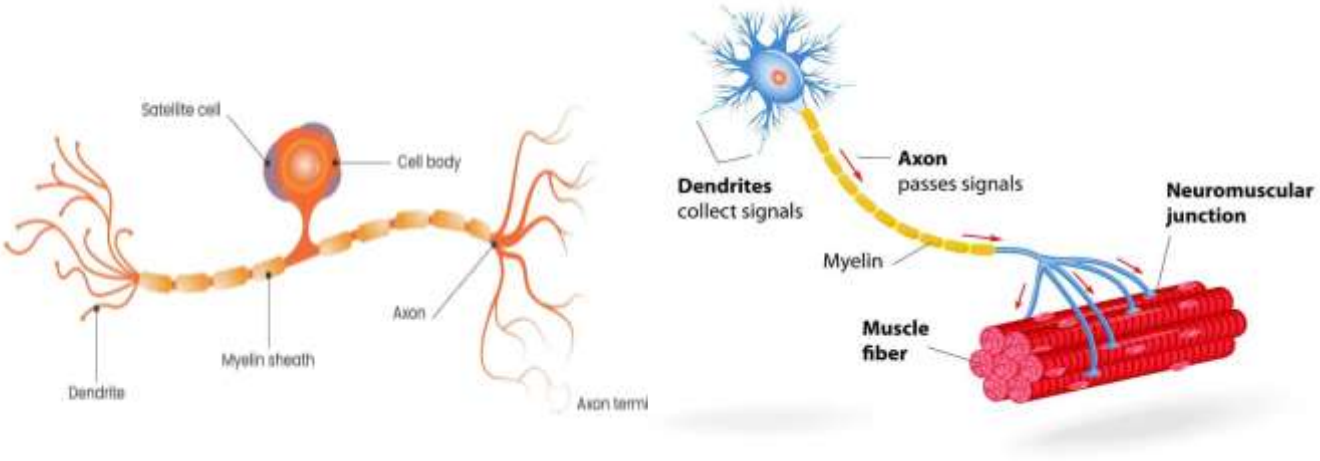

(b) In a phototropic experiment, thin pieces of mica were inserted into three tips of coleoptiles as shown in Figure 2 below.
Use the auxin theory to predict and explain the results of experiments A, B, and C.

- Experiment A: Auxin is distributed evenly, causing uniform elongation and no bending.
- Experiment B: The mica block prevents auxin flow, resulting in no bending as auxin cannot reach the elongation site.
- Experiment C: Auxin accumulates on the shaded side, causing cell elongation and the tip bending toward the light source.

12. (a) What is ATP?

ATP (Adenosine Triphosphate) is the energy currency of the cell, consisting of adenine, ribose, and three phosphate groups. It stores and transfers energy for cellular processes.

(b) Outline the respiratory pathway using lipid and protein substrates.

- Lipids: Broken down into glycerol and fatty acids. Glycerol enters glycolysis, while fatty acids undergo beta-oxidation to form acetyl-CoA, which enters the Krebs cycle.
- Proteins: Broken down into amino acids. Deaminated amino acids enter glycolysis or the Krebs cycle as intermediates.

13. (a) How is the phloem tissue adapted for the transport of materials?

Phloem tissue has sieve tube elements with perforated sieve plates for easy flow of sap. Companion cells provide metabolic support, while plasmodesmata connect cells for efficient transfer.

(b) Give the function and location of the Casparian strip.

The Casparian strip is found in the endodermis of roots and ensures selective mineral uptake by blocking passive flow through the apoplast pathway.

14. (a) (i) Define metamorphosis.

Metamorphosis is a biological process by which an organism undergoes significant physical changes in structure and function during its development, such as the transformation of a larva into an adult.

(ii) Give the significance of metamorphosis.

i. Allows specialization of life stages for different functions (e.g., feeding vs. reproduction).
ii. Reduces competition for resources between larval and adult stages.

(b) Explain why small mammals have a higher metabolic rate than big ones.

Small mammals lose heat faster due to a larger surface-area-to-volume ratio. To maintain body temperature, they have higher metabolic rates to generate sufficient energy.

15. In figures 3(a) and 3(b) below, label structures A-H. What is the main function of each structure?

Figure 3(a): Female reproductive system
A - Ovary: Produces eggs and hormones.
B - Fallopian tube: Transports eggs from ovary to uterus.
C - Uterus: Supports fetal development.
D - Cervix: Connects uterus to vagina and acts as a barrier.
E - Vagina: Passageway for childbirth and sexual intercourse.
F - Urethra: Excretes urine.
G - Bladder: Stores urine.
H - Kidney: Filters blood and produces urine.

Figure 3(b): Male reproductive system
A - Testis: Produces sperm and testosterone.
B - Epididymis: Stores and matures sperm.
C - Vas deferens: Transports sperm.
D - Prostate gland: Produces seminal fluid.
E - Urethra: Excretes urine and ejaculates sperm.
F - Bladder: Stores urine.
G - Penis: Delivers sperm during intercourse.
H - Kidney: Filters blood and produces urine.