THE UNINTED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION AND CULTURE

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

133/2 **BIOLOGY 2**

Time: 2:30 Hours **ANSWERS** **Year: 2011**

Instructions:

1. this paper consists of six questions
2. answer five questions
3. Each question carries twenty marks.

1. a. i. Besides vitamins and hormones which occur only in certain cells in small amounts, list three most common but important substances of a cell. For each substance, indicate the chemical composition and two sites of production as shown in the table below.

Substance:

- Carbohydrates
  Chemical composition: Carbon (C), Hydrogen (H), Oxygen (O)
  Sites of production: Chloroplast (plants), Cytoplasm (animals)

- Proteins
  Chemical composition: Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Sulfur (S)
  Sites of production: Ribosomes, Rough Endoplasmic Reticulum

- Lipids
  Chemical composition: Carbon (C), Hydrogen (H), Oxygen (O)
  Sites of production: Smooth Endoplasmic Reticulum, Cytoplasm

ii. From the chemical composition shown above, list four main chemical elements which constitute a living matter.

- Carbon (C)
- Hydrogen (H)
- Oxygen (O)
- Nitrogen (N)

b. Enzymes are highly specific. Explain this concept giving a relevant example.
Enzymes are highly specific because they act on only one type of substrate due to the specific shape of their active site. The lock-and-key mechanism explains this specificity, where the enzyme (lock) fits perfectly with its substrate (key). For example, amylase breaks down starch into maltose but does not act on proteins or fats.

2. a. Identify the organism in Figure 1 and name the structures labeled a-g.
Organism: Rhizopus (a type of fungi)
a. Hypha
b. Sporangiophore
c. Sporangium
d. Spores
e. Columella
f. Stolons
g. Rhizoids

b. Discuss the adaptations of the organism in Figure 1 to its mode of life.
i. Hypha: Extends and grows into food sources, aiding in absorption of nutrients.
ii. Sporangiophore: Elevates the sporangium for better dispersal of spores.

iii. Sporangium: Produces and stores spores for reproduction.
iv. Spores: Lightweight and resistant to unfavorable conditions, allowing dispersal.
v. Stolons: Spread horizontally to colonize a large area.
vi. Rhizoids: Anchor the organism to the substrate and absorb nutrients.
vii. Columella: Supports the sporangium and ensures proper spore formation.

3. a. Define:
i. Taxis: A directional movement of an organism in response to a stimulus, such as light or chemicals.
ii. Nasties: Non-directional responses of an organism to stimuli, such as temperature or humidity changes.

b. Why are tactic movements very important to life and the existence of organisms?
i. Help organisms locate food sources.
ii. Aid in escaping predators.
iii. Facilitate movement toward favorable environments.
iv. Enable reproduction by guiding gametes to one another.
v. Support survival by avoiding harmful stimuli.

c. What are the differences between hormonal and nervous control in animals?
i. Hormonal control is slow, while nervous control is fast.
ii. Hormonal effects last longer, while nervous effects are short-term.
iii. Hormones are transported through the bloodstream, while nerve impulses travel via neurons.
iv. Hormonal control is involuntary, while nervous control can be voluntary or involuntary.
v. Hormones affect target organs, while nerves can directly stimulate specific muscles or glands.

4.a. Explain briefly the role of the following in digestion:

i. Columnar epithelium:
The columnar epithelium lines the stomach and intestines and is responsible for secretion and absorption. It secretes digestive enzymes and mucus that aid in the digestion and protection of the digestive tract.

ii. Secretin hormone:
Secretin stimulates the pancreas to release bicarbonate ions into the duodenum, neutralizing the acidic chyme from the stomach, and optimizing the pH for enzyme activity in the small intestine.

iii. Cholecystokinin Pancreozymin (CCK-P2) hormone:
This hormone stimulates the gallbladder to contract and release bile into the duodenum, aiding fat emulsification. It also stimulates the pancreas to release digestive enzymes for protein, carbohydrate, and fat digestion.

iv. Enterogastrone hormone:
Enterogastrone slows down gastric emptying and inhibits the secretion of gastric juices, allowing more time for digestion and nutrient absorption in the small intestine.

b. Figure 2 shows the rate of photosynthesis in two species of plants at different light intensities.

i. Which species shows the best adaptation to shady conditions? Give reasons for your answer.
Species B shows the best adaptation to shady conditions because its photosynthetic rate is higher at low light intensities. This indicates that it has a more efficient light-harvesting mechanism in low-light environments.

ii. Apart from light intensity, mention one other way in which light in a shady area differs from that in a sunny area.
Light in shady areas often has a different wavelength composition, with more green and far-red light and less blue and red light compared to light in sunny areas.

iii. Many plant species that grow in the shade have low rates of respiration. What is the possible advantage of this?
Low respiration rates in shade plants reduce energy consumption, allowing them to conserve energy for growth and reproduction under limited light conditions.

5. a. Explain why in cold weather humans produce more dilute urine than in hot weather.
In cold weather, humans sweat less, leading to less water loss through the skin. Consequently, the kidneys excrete more water to maintain water balance, resulting in more dilute urine. In contrast, hot weather increases sweating, and the kidneys conserve water, producing concentrated urine.

b. What advantages do mammals have in using urea as a nitrogenous waste product?
i. Urea is less toxic compared to ammonia, allowing mammals to store and transport it in the body for excretion.
ii. Urea requires less water for excretion, which helps in water conservation.
iii. Urea can be concentrated in the urine, minimizing water loss and aiding survival in dry environments.

6. a. State the role(s) of the following structures:

i. Casparian strip:
The Casparian strip in root endodermal cells regulates the flow of water and dissolved substances into the xylem by forcing them to pass through the selectively permeable membranes of the endodermal cells.

ii. Transfer cells in a leaf:
Transfer cells increase the surface area for solute exchange, aiding in the transport of nutrients between the mesophyll cells and the phloem.

b. Giving examples, distinguish closed circulatory systems from open circulatory systems.
i. In a closed circulatory system, blood flows entirely through vessels, e.g., in vertebrates like humans and fish.
ii. In an open circulatory system, blood bathes tissues directly in open spaces (sinuses), e.g., in arthropods like insects and mollusks.

7. a. Describe the formation of a pollen grain and embryo sac in a flowering plant.
i. Pollen grain: In the anther, diploid microspore mother cells undergo meiosis to form haploid microspores. Each microspore develops into a pollen grain containing a tube nucleus and a generative nucleus.
ii. Embryo sac: In the ovule, a diploid megaspore mother cell undergoes meiosis to form four haploid megaspores, one of which survives. The surviving megaspore undergoes mitosis to form an embryo sac containing eight nuclei.

b. Explain how non-endospermic seeds develop.
In non-endospermic seeds, the cotyledons absorb nutrients from the endosperm during seed development. By the time the seed matures, the endosperm is entirely consumed, and the cotyledons act as storage tissues for nutrients to support germination.

8. a. Define "Selection" as applied in evolution studies.
Selection is the process by which certain traits become more common in a population due to their advantage in survival and reproduction, influenced by environmental pressures.

b. Explain how the following support the theory of organic evolution:
i. Comparative embryology: Similarities in embryonic development among different species indicate common ancestry. For example, vertebrate embryos have pharyngeal slits and tail structures, suggesting a shared evolutionary origin.
ii. Paleontology: Fossil records show gradual changes in species over time, supporting the concept of descent with modification.
iii. Taxonomy: The classification of organisms based on shared characteristics reflects evolutionary relationships and common ancestry.

9. a. i. What are natural resources?
Natural resources are materials and components found in nature that can be used by humans for economic, environmental, or survival purposes. These include renewable resources like water, soil, and forests, as well as non-renewable resources like minerals and fossil fuels.

ii. Using relevant examples, describe the two main types of natural resources.
- Renewable resources: These are resources that can replenish themselves naturally over time if used sustainably. Examples include forests, which regenerate through growth; water, which replenishes through the hydrological cycle; and solar energy, which is continuously available.
- Non-renewable resources: These are resources that exist in finite amounts and do not regenerate at a significant rate once consumed. Examples include fossil fuels like coal and petroleum, as well as minerals like gold and copper.

b. Why is it wise to use environmental resources sustainably?
i. To ensure the long-term availability of resources for future generations by preventing depletion or extinction.
ii. To maintain ecological balance by preserving biodiversity and natural ecosystems.

iii. To prevent environmental degradation, such as soil erosion, deforestation, and pollution.
iv. To reduce the risk of economic collapse due to the exhaustion of critical resources.
v. To combat climate change by protecting carbon sinks such as forests and reducing reliance on fossil fuels.

c. Explain how a quadrat can be used to carry out an ecological study of a plant species.

i. A quadrat is a square or rectangular frame used for sampling in ecological studies.
ii. The quadrat is randomly placed in different areas within the habitat of the plant species being studied.
iii. The plants within the quadrat are identified, counted, or measured to estimate parameters like population density, frequency, and coverage.
iv. Multiple quadrat samples are taken to ensure accurate representation and reliability of the data.
v. Data from the quadrats is then analyzed to determine the abundance, distribution, and diversity of the plant species.