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: 1998**

Instructions:

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

1. (a) The diagram below represents a small portion of the molecular structure of a nucleic acid

i. Name the part of the molecule indicated by the dotted box labelled X.
The dotted box labelled X represents a nitrogenous base.

ii. What do the letters A, C, D, G, P, and T in the diagram represent?
- A: Adenine
- C: Cytosine
- D: Deoxyribose sugar
- G: Guanine
- P: Phosphate group
- T: Thymine

iii. What type of chemical bond is found at the point indicated by an arrow labelled Y?
The bond indicated by Y is a hydrogen bond.

(b) Describe the properties which account for the DNA's suitability as material for heredity.
i. DNA has a stable structure due to the double-helix configuration, which ensures accurate replication and storage of genetic information.
ii. It is capable of self-replication, allowing genetic information to be passed from one generation to another.
iii. DNA has the ability to store vast amounts of information in the sequence of its bases, which determine the genetic instructions.
iv. Its complementary base-pairing mechanism ensures fidelity during replication and transcription.

2. (a) Compare the body plans in T.S. of hydra and earthworm.

Hydra and earthworms exhibit distinct body plans, especially when observed in transverse section (T.S.). Below is a comparison of their key structural features:

Hydra:
i. Symmetry: Radial symmetry, allowing the organism to interact with the environment from all sides equally.
ii. Germ Layers: Diploblastic, consisting of two primary layers:
  - Epidermis: The outer layer derived from ectoderm.
  - Gastrodermis: The inner layer derived from endoderm, lining the gastrovascular cavity.
iii. Mesoglea: A non-cellular, gelatinous substance situated between the epidermis and gastrodermis, providing structural support.
iv. Body Cavity: Lacks a true coelom; possesses a central gastrovascular cavity that functions in both digestion and distribution of nutrients.
v. Segmentation: Absent; the body is a simple, unsegmented tube.

Earthworm:

i. Symmetry: Bilateral symmetry, with a distinct dorsal and ventral side, as well as anterior and posterior ends.
ii. Germ Layers: Triploblastic, comprising three primary layers:
- Ectoderm: Forms the outer body covering.
- Mesoderm: Develops into muscles, the coelom lining, and internal structures.
- Endoderm: Lines the digestive tract.

iii. Coelom: A true coelom (body cavity) fully lined by mesodermal tissue, partitioned by septa into segments, providing space for organ development and function.

iv. Segmentation: The body is divided into multiple segments (metameres), each containing repeated structures such as nephridia and setae, facilitating movement and flexibility.

v. Body Wall: Composed of an outer circular muscle layer and an inner longitudinal muscle layer, enabling peristaltic movement.

vi. Digestive System: A complete, unsegmented digestive tract running from mouth to anus, specialized into regions like the pharynx, esophagus, crop, gizzard, and intestine.

(b) i. What is a coelom?
A coelom is a fluid-filled body cavity completely lined by mesodermal tissue, found in most multicellular animals.

ii. Give the functions of a coelom.
- Provides space for the development and suspension of internal organs.
- Acts as a hydrostatic skeleton for support and movement in some animals.
- Allows the transport of nutrients, gases, and wastes within the body.
- Facilitates organ growth and movement independently of the body wall.

3. (a) State the lowest classification taxon at which a cobra and a human are grouped together. Give reasons to support your answer.
The lowest classification taxon is Class (Chordata), as both cobra and humans share characteristics such as having a notochord, dorsal nerve cord, and pharyngeal slits during embryonic development.

(b) Some biologists propose viruses to be living. What is their argument?
Viruses are considered living because they can reproduce, evolve, and respond to selective pressures when inside a host cell.

4. (a) i. Give a reasoned interpretation of the graph.
The graph shows the effect of substrate concentration on enzyme activity. At low substrate concentration, the reaction rate increases as more substrate molecules bind to enzymes. However, at higher substrate concentrations, the reaction rate levels off, indicating saturation where all active sites are occupied.

ii. How can the rate of reaction be increased?
- By increasing enzyme concentration.
- By maintaining optimal pH and temperature for enzyme activity.

(b) What is the commercial importance of cellulose?
- Used in the production of paper, textiles, and biofuels.
- Serves as a dietary fiber for improving human digestion.
- Used in producing cellulose derivatives like cellophane and rayon.

5. (a) i. Define the term photophosphorylation.
Photophosphorylation is the process of generating ATP from ADP and inorganic phosphate using light energy during photosynthesis.
ii. List three differences between cyclic and non-cyclic photophosphorylation.
- Cyclic photophosphorylation involves only photosystem I, while non-cyclic involves both photosystems I and II.
- Cyclic does not produce NADPH, while non-cyclic does.
- Cyclic does not involve photolysis of water, while non-cyclic involves water splitting.

(b) Explain why it is important that active transport is employed in the absorption of end products of digestion.
Active transport ensures efficient absorption of nutrients like glucose and amino acids against their concentration gradients, which is vital for meeting the body's metabolic demands.
6. (a) i. What is respiratory quotient (RQ)?
The respiratory quotient is the ratio of carbon dioxide produced to oxygen consumed during respiration.

ii. Using examples, briefly explain when you would expect the RQ to be 1, less than 1, and greater than 1.
- RQ is 1 when carbohydrates are the substrate (e.g., glucose).
- RQ is less than 1 when fats or proteins are used as substrates.
- RQ is greater than 1 during anaerobic respiration or fermentation.

(b) Differentiate between endothermy and ectothermy and give two examples of organisms for each case.
Endothermy refers to organisms that maintain a constant internal body temperature (e.g., birds and mammals).
Ectothermy refers to organisms whose body temperature varies with the environment (e.g., reptiles and amphibians).

7. (a) Study careful the diagram of a mammalian nephron with associated blood vessels shown below

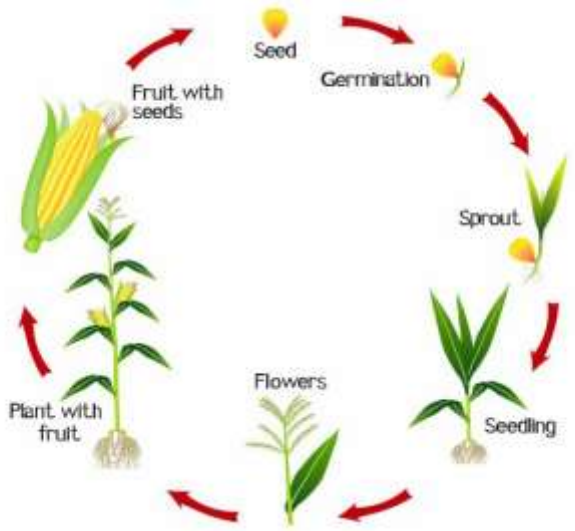
i. Label the structures indicated by letters A, B, C, D, E, F, and G.
A: Glomerulus
B: Afferent arteriole
C: Bowman's capsule
D: Efferent arteriole
E: Proximal convoluted tubule
F: Loop of Henle
G: Collecting duct
ii. By using the letters shown in the diagram, trace the path of blood entering and leaving the nephron.
Blood enters the nephron through the afferent arteriole (B), which leads into the glomerulus (A) where filtration occurs. The filtered blood exits the glomerulus through the efferent arteriole (D) and flows into the peritubular capillaries surrounding the nephron.

iii. What is the functional significance of having blood vessel B larger than blood vessel E?
The afferent arteriole (B) is larger than the efferent arteriole (D) to create a higher pressure in the glomerulus. This pressure difference is essential for the filtration of blood plasma into the Bowman's capsule, initiating the process of urine formation.

(b) A deep-sea fisherman has exhausted his supply of fresh water while he is still far from land. As his thirst gets worse, he resolves to drinking seawater and eating large quantities of fish. Explain why this will increase rather than lessen his problem.
i. Seawater has a high salt concentration, which increases the osmotic pressure in the body. This leads to dehydration as more water is required to excrete the excess salt.
ii. Consuming large amounts of fish can also introduce additional salts, further increasing the body's osmotic load.
iii. Instead of relieving thirst, the body loses more water through increased urination to eliminate the high salt content, exacerbating dehydration.

8. (a) i. Distinguish between localized growth and diffuse growth.
Localized growth occurs in specific regions of an organism, such as the tips of roots and shoots in plants. Diffuse growth occurs throughout the organism's body, as seen in the growth of cells in the epidermis or mesophyll.

ii. State any three factors which influence growth in animals.
- Nutrition: Adequate intake of proteins, vitamins, and minerals promotes proper growth.
- Hormones: Growth hormones, such as somatotropin, regulate growth by stimulating cell division and elongation.
- Genetics: Hereditary traits determine growth potential, including size and metabolic rates.
(b) By means of a diagram, show the life cycle of a maize plant.
The life cycle of a maize (corn) plant encompasses several stages, from seed germination to the production of mature seeds. Below is a diagram illustrating these stages:



Stages of the Maize Life Cycle:

i. Seed

The life cycle begins with a maize seed, which contains the embryo and stored nutrients necessary for germination.

ii. Germination

When planted in suitable soil conditions with adequate moisture and warmth, the seed absorbs water, swells, and the embryo begins to grow. The radicle (embryonic root) emerges first, followed by the shoot.

iii. Seedling

The young plant develops its initial leaves and establishes a root system, enabling it to perform photosynthesis and gather nutrients from the soil.

iv. Vegetative Growth

The maize plant undergoes rapid growth, producing additional leaves and a stronger stem. During this phase, the plant focuses on accumulating resources necessary for reproduction.

v. Tasseling (VT Stage)

The plant produces a tassel at the top, which contains the male flowers responsible for producing pollen.

vi. Silking (R1 Stage)

Silks, which are the styles of the female flowers, emerge from the ear shoots located along the stem. Each silk is connected to a potential kernel.

vii. Pollination

Pollen from the tassels is transferred to the silks, typically by wind. Successful pollination leads to fertilization, initiating kernel development.

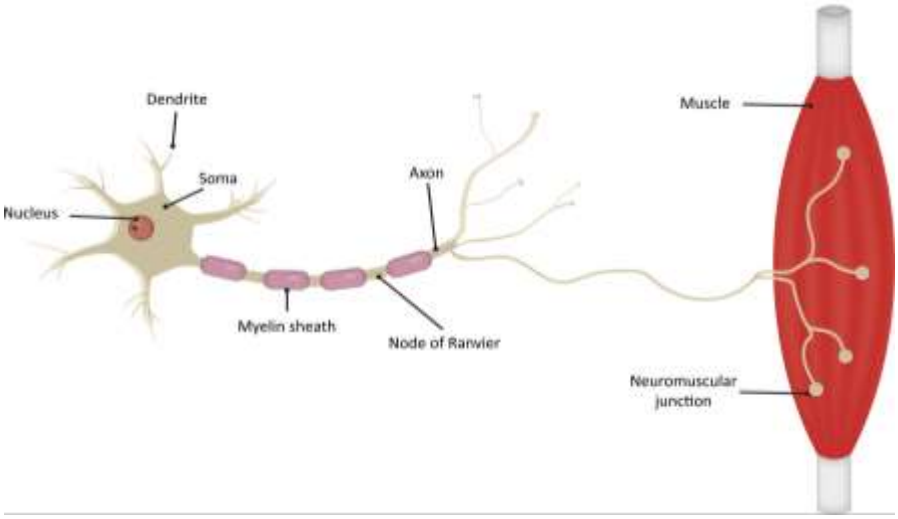
viii. Kernel Development

Following fertilization, kernels develop through stages such as blister (R2), milk (R3), dough (R4), and dent (R5), culminating in physiological maturity (R6) when kernels reach maximum dry weight.

ix. Mature Plant

Once the kernels have matured, the plant begins to senesce, and the kernels can be harvested as seeds to begin a new life cycle.

9. Draw a labeled diagram of a mammalian motor neuron.



10. (a) Why is it not possible to use a homozygous dominant organism in a back cross (test cross) experiment to determine the genotype of an organism showing the dominant phenotype? Illustrate your answer fully.
i. A homozygous dominant organism would produce offspring with only the dominant phenotype, regardless of the genotype of the organism being tested.
ii. A test cross requires the use of a homozygous recessive organism to distinguish between homozygous dominant and heterozygous genotypes.
iii. For example, crossing a homozygous dominant organism (TT) with a homozygous recessive organism (tt) would yield all dominant phenotype offspring (Tt), making it impossible to confirm the genotype.

(b) Categorize the following list of human traits into continuous and discontinuous traits:
i. Continuous traits: Height, intelligence, skin color.
ii. Discontinuous traits: Tongue rolling, blood groups, sex.

11. (a) State any four factors which influence population distribution.
i. Availability of resources: Areas with abundant resources, such as water and fertile soil, attract higher population densities.
ii. Climate: Favorable climates support higher populations, while extreme climates discourage settlement.
iii. Topography: Flat and accessible terrains are more densely populated compared to rugged or mountainous regions.
iv. Economic opportunities: Regions with better job prospects and infrastructure attract more people.

(b) i. What do you understand by the term "global warming"?
Global warming refers to the increase in Earth's average surface temperature due to the accumulation of greenhouse gases, such as carbon dioxide and methane, in the atmosphere.

ii. Briefly explain how it is caused.

It is caused by human activities like burning fossil fuels, deforestation, and industrial emissions, which release greenhouse gases into the atmosphere, trapping heat.

iii. What can you as an individual do to contribute toward slowing down "global warming"?
- Reduce energy consumption by using energy-efficient appliances and practices.
- Plant trees to absorb carbon dioxide.
- Use public transportation or carpool to reduce fossil fuel emissions.

12. (a) What is a fossil? Very briefly describe how fossils are formed.
A fossil is the preserved remains, impressions, or traces of organisms that lived in the past. Fossils are formed when an organism is buried by sediment, and over time, the organic material is replaced by minerals, creating a rock-like replica of the original structure.

(b) Summarize the deductions which Lamarck used to arrive at his theory of evolution.
i. Use and disuse: Organs used frequently become stronger and more developed, while unused organs deteriorate.
ii. Inheritance of acquired traits: Traits acquired during an organism's lifetime can be passed on to its offspring.
iii. Change over time: Organisms adapt to their environment over generations, leading to the evolution of new species.