THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL

DIPLOMA IN SECONDARY EDUCATION EXAMINATION

733/1 **BIOLOGY 1**

Time: 3 Hour. **ANSWERS** **Year: 2017**

Instructions

1. This paper has Section A, B and C.
2. Answer **all** questions from Section A and **two (2)** questions from Section B and C each.
3. Section A and B carry 30 marks each and Section C carries 40 marks.
4. Mobile phones are not allowed inside the examination room.
5. Write your Examination Number on every page of your answer booklet.

SECTION A (30 Marks)

Answer all questions from this section.

1. List four features that distinguish annelids from arthropods.

One feature that distinguishes annelids from arthropods is the presence of a segmented body with internal partitions in annelids, whereas arthropods have segmented bodies without internal septa. Annelids like earthworms have true segmentation, with each segment separated internally, which allows for more flexible movement.

A second difference is that annelids have a hydrostatic skeleton, while arthropods possess a rigid exoskeleton made of chitin. The hydrostatic skeleton allows annelids to move through contraction of muscles and fluid pressure, while the exoskeleton in arthropods provides external protection and support but requires moulting for growth.

Thirdly, annelids have simple parapodia or setae used for locomotion, whereas arthropods have jointed appendages such as legs, antennae, and pincers. These jointed limbs provide arthropods with better movement and manipulation of their environment.

Lastly, annelids typically possess a closed circulatory system, while many arthropods have an open circulatory system. In annelids, blood flows through enclosed vessels, ensuring efficient transport of nutrients and gases, while in arthropods, blood flows into body cavities, bathing organs directly.

2. Briefly explain four biological factors that influence population size in an ecosystem.

One biological factor that influences population size is the birth rate. When the birth rate in a population is high, the number of individuals increases, leading to a rise in population size, provided other factors like mortality are low.

A second factor is the death rate or mortality rate. High mortality, especially due to disease or predation, can reduce the population size over time, even if the birth rate remains constant.

Another factor is competition. Intra-specific and inter-specific competition for food, shelter, mates, and other resources can limit population growth. When resources are scarce, fewer individuals survive and reproduce, thus keeping population size in check.

Lastly, predation plays a key role. When predator populations are high, they can reduce prey populations significantly. This interaction often results in population cycles where prey and predator numbers fluctuate based on availability and reproduction rates.

3. Mention four laboratory safety practices that should be observed when handling corrosive chemicals.

One safety practice is the use of personal protective equipment such as gloves, goggles, and lab coats. This helps prevent chemical burns or injuries caused by accidental splashes of corrosive substances.

A second practice is ensuring proper labeling of all chemical containers. Clearly marked containers help prevent misuse or accidental mixing, which can be dangerous with corrosive chemicals.

Thirdly, corrosive chemicals should always be handled in well-ventilated areas, preferably under a fume hood. This reduces the inhalation of harmful vapors which could damage respiratory tissues.

Lastly, it's important to always add acid to water, not the other way around, when diluting corrosive acids like sulfuric acid. This practice prevents the solution from splashing or boiling violently, reducing the risk of injury.

4. State four differences between mitosis and meiosis.

One difference is that mitosis results in two genetically identical daughter cells, while meiosis produces four genetically distinct daughter cells. This makes mitosis suitable for growth and repair, and meiosis essential for sexual reproduction.

Secondly, mitosis involves one cell division, whereas meiosis includes two successive divisions: meiosis I and meiosis II. The additional division in meiosis is necessary to reduce the chromosome number by half.

Another distinction is that mitosis maintains the diploid chromosome number of the original cell, while meiosis reduces it from diploid to haploid, ensuring the correct chromosome number in gametes.

Finally, crossing over and recombination of genetic material occurs in prophase I of meiosis but not in mitosis. This genetic recombination increases variation in the offspring, which is critical in evolution and adaptation.

5. Describe four characteristics of enzymes that support their function in living organisms.

One key characteristic is that enzymes are highly specific to their substrates. Each enzyme acts on a particular type of molecule, allowing precise control of metabolic reactions in cells.

Secondly, enzymes are protein in nature and function as biological catalysts. This means they speed up chemical reactions in the body without being consumed in the process.

A third property is that enzymes operate best within an optimal range of temperature and pH. Any deviation from these conditions can reduce enzyme activity or denature the enzyme entirely.

Finally, enzymes work very efficiently even in small amounts. A single enzyme molecule can catalyze thousands of reactions per second, making them crucial in maintaining the body's rapid biochemical processes.

6. Give four examples of communicable diseases and their causative agents.

One example is malaria, which is caused by a protozoan parasite known as *Plasmodium*, and is transmitted by the female Anopheles mosquito.

Secondly, tuberculosis is a communicable disease caused by the bacterium *Mycobacterium tuberculosis*, which spreads through airborne droplets when an infected person coughs or sneezes.

Another example is HIV/AIDS, caused by the Human Immunodeficiency Virus. It is transmitted through body fluids such as blood, semen, and breast milk.

Lastly, cholera is caused by the bacterium *Vibrio cholerae*. It spreads through contaminated water and food, often in areas with poor sanitation.

7. Briefly explain the importance of lesson plan evaluation to a Biology teacher.

Lesson plan evaluation allows the teacher to assess the effectiveness of the teaching strategies used. By reflecting on what worked and what did not, the teacher can make informed adjustments for future lessons.

It also helps identify whether the learning objectives were achieved. If students did not meet the expected outcomes, the teacher can identify gaps and reinforce concepts in subsequent lessons.

Evaluating a lesson helps in improving student engagement by reviewing student responses, behavior, and participation. This can guide the teacher to adopt more interactive or differentiated methods.

Lastly, lesson plan evaluation assists in professional growth. Through continuous reflection, a teacher hones their instructional skills, thereby improving their confidence and competence in classroom delivery.

8. Outline four criteria for selecting effective teaching aids in Biology.

One important criterion is relevance. Teaching aids must be directly related to the topic being taught to help students understand the specific concepts clearly.

Secondly, the aid should be appropriate for the students' level of understanding. Age, class level, and prior knowledge should be considered when choosing materials.

A third criterion is availability and cost. The teaching aid should be affordable and easily accessible to the teacher, especially in resource-limited schools.

Finally, it should be durable and safe for classroom use. Teaching aids that can be reused without damage and are free from hazardous materials are preferable.

9. State four factors that affect the rate of diffusion across cell membranes.

One factor is the concentration gradient. The greater the difference in concentration between two areas, the faster the rate of diffusion.

Secondly, temperature affects diffusion. Higher temperatures increase the kinetic energy of molecules, thus speeding up their movement across membranes.

Another factor is the surface area of the membrane. A larger surface area allows more molecules to diffuse at a given time, increasing the overall rate.

Lastly, the size and nature of the diffusing molecules also matter. Smaller, non-polar molecules diffuse more easily than larger or charged molecules through cell membranes.

10. List four differences between monocotyledonous and dicotyledonous plants.

One difference is that monocots have one cotyledon in their seeds, while dicots have two. This is the most basic distinction used in seed classification.

Secondly, monocots typically exhibit parallel leaf venation, whereas dicots have a network or reticulate venation in their leaves.

Another difference is in the arrangement of vascular bundles. In monocots, these are scattered throughout the stem, while in dicots, they are arranged in a ring.

Finally, monocots usually have fibrous root systems, whereas dicots develop a main taproot from which lateral roots emerge.

SECTION B (30 Marks)

Answer two questions from this section.

11. Explain the structure and functions of the human respiratory system. Use relevant diagrams where necessary.

The human respiratory system is made up of several organs that work together to facilitate the exchange of gases between the body and the environment. The main components include the nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, and lungs, particularly the alveoli where gas exchange occurs.

The nasal cavity filters, warms, and moistens the air before it enters the lungs. Tiny hairs called cilia trap dust and microorganisms, while mucus keeps the airways moist and helps trap further particles.

The pharynx and larynx serve as passageways for air to move from the nasal cavity to the trachea. The larynx, or voice box, also contains vocal cords and is protected by the epiglottis, which prevents food from entering the trachea during swallowing.

The trachea, commonly known as the windpipe, is a tube supported by C-shaped cartilage rings to prevent collapse. It conducts air into the bronchi and also contains ciliated epithelial cells that help clear mucus and debris.

The trachea divides into two bronchi, each leading to a lung. These bronchi further divide into smaller tubes called bronchioles. These bronchioles help distribute air throughout the lungs and lead to clusters of alveoli.

Alveoli are tiny sac-like structures with thin walls surrounded by capillaries. This is the site of gas exchange. Oxygen diffuses from the alveoli into the blood, and carbon dioxide diffuses from the blood into the alveoli to be exhaled.

Inhalation is an active process involving the diaphragm and intercostal muscles, which contract to expand the thoracic cavity. This reduces pressure in the lungs, drawing air in. Exhalation is usually passive, where muscles relax and air is pushed out.

The respiratory system plays a crucial role in maintaining homeostasis by regulating blood pH and ensuring adequate oxygen supply for cellular respiration, while removing carbon dioxide, a metabolic waste.

12. Discuss the adaptations of xerophytes to survive in arid environments.

Xerophytes are plants adapted to live in dry environments such as deserts. They possess structural and physiological adaptations that enable them to minimize water loss and make efficient use of the little water available.

One common adaptation is the development of thick, waxy cuticles on their leaves and stems. This cuticle acts as a waterproof layer, reducing the rate of transpiration and preventing water loss.

Some xerophytes have reduced or modified leaves such as spines, as seen in cacti. This reduces the surface area available for water loss and protects the plant from herbivores.

Many xerophytes possess sunken stomata located in pits on the leaf surface. These stomata are often fewer in number and open only at night (a process known as CAM photosynthesis), which reduces water loss due to lower night temperatures.

Some plants like succulents store water in fleshy leaves or stems. This allows the plant to use the stored water during prolonged dry periods.

Xerophytes may also develop deep or extensive shallow root systems. Deep roots tap underground water, while widespread shallow roots absorb moisture from light rains quickly.

Additionally, some xerophytes roll their leaves to trap moist air inside, which helps maintain humidity and reduce transpiration from the inner surfaces.

All these adaptations work together to ensure the survival of xerophytes in environments where water is scarce and evaporation rates are high.

13. Describe the process of photosynthesis, including the stages and significance to living organisms.

Photosynthesis is the process by which green plants, algae, and some bacteria convert light energy into chemical energy, using water and carbon dioxide to produce glucose and release oxygen. This process occurs in the chloroplasts of plant cells, primarily in leaves.

Photosynthesis occurs in two major stages: the light-dependent reactions and the light-independent reactions (Calvin cycle). The light-dependent reactions take place in the thylakoid membranes of chloroplasts and require sunlight.

During the light-dependent stage, chlorophyll absorbs sunlight, which energizes electrons. Water molecules are split into hydrogen and oxygen through photolysis. The oxygen is released as a byproduct, while the hydrogen ions and high-energy electrons are used to form ATP and NADPH.

The second stage, the light-independent reactions or Calvin cycle, takes place in the stroma of the chloroplast. Carbon dioxide from the atmosphere is fixed into organic molecules using the energy stored in ATP and NADPH produced in the previous stage.

Through a series of enzyme-controlled reactions, carbon dioxide is converted into glucose, which can then be used immediately for energy or stored as starch for later use.

Photosynthesis is significant because it is the primary source of energy for nearly all life forms. It produces the oxygen necessary for aerobic respiration and forms the base of the food chain by supplying energy-rich organic compounds to heterotrophs.

Moreover, photosynthesis plays a crucial role in regulating atmospheric carbon dioxide, which helps mitigate climate change. It is also responsible for the biomass that supports agriculture, forestry, and fuel.

14. With examples, discuss five types of asexual reproduction in living organisms and their advantages.

One type of asexual reproduction is binary fission, commonly seen in bacteria and protozoa like *Amoeba*. In this process, a single organism duplicates its genetic material and splits into two identical daughter cells.

Budding is another form, where a new organism develops from an outgrowth or bud on the parent. *Hydra* and yeast exhibit this method. The bud eventually detaches and becomes independent.

Fragmentation is seen in organisms like *Planaria* and certain algae. When the organism breaks into parts, each fragment can regenerate into a new individual, thus increasing population quickly.

Spore formation is a method used by fungi, some algae, and mosses. Spores are lightweight, resistant structures that disperse easily and germinate under favorable conditions, forming new individuals.

Vegetative propagation is common in plants, where new individuals arise from roots, stems, or leaves. Examples include potato tubers, onion bulbs, and runners in strawberries.

The main advantages of asexual reproduction are that it is faster, requires less energy, and does not depend on finding a mate. It also allows for rapid colonization of favorable environments and ensures the preservation of successful genotypes.

SECTION C (40 Marks)

Answer two questions from this section.

15. As a Biology teacher, explain six important aspects to consider when preparing to teach a lesson on digestion in humans.

The first important aspect is identifying the lesson objectives. A Biology teacher should clearly define what students are expected to know and be able to do by the end of the lesson. These objectives should align with the curriculum and be specific, measurable, and achievable within the lesson period.

Second, the teacher must assess learners' prior knowledge. Before teaching digestion, the teacher should determine what students already know about the topic. This helps in designing appropriate content and linking new concepts to existing knowledge for better understanding.

A third consideration is selecting suitable teaching and learning materials. For a lesson on digestion, the teacher might prepare charts of the digestive system, models of organs, videos, or real specimens. These aids help to make abstract content more concrete and improve student engagement.

The fourth aspect is deciding on appropriate teaching methods. Since digestion involves processes and structures, the teacher should consider demonstrations, group discussions, or inquiry-based methods to enhance learner participation and conceptual clarity.

Another important factor is planning for assessment. The teacher must design ways to evaluate whether the objectives were achieved. This might include oral questioning, written exercises, or practical tasks at the end of the lesson to assess understanding.

Finally, classroom management strategies must be considered. The teacher should prepare for how to organize the class, manage time effectively, and ensure that learners stay focused. This includes assigning tasks, setting rules for lab use, and preparing a backup plan in case of interruptions.

16. Describe six roles of the teacher during Biology practical sessions and how they influence students' skill acquisition.

The first role is to guide and supervise learners. During practical sessions, the teacher must ensure students follow correct procedures and handle equipment safely. This helps learners acquire confidence and good laboratory habits.

Second, the teacher acts as a demonstrator. Before learners perform an experiment, the teacher may need to demonstrate the procedure. This visual guidance enhances learners' understanding of the task and minimizes errors.

Third, the teacher provides support and feedback. While students are working, the teacher should observe and offer corrective advice. Timely feedback helps learners correct mistakes and develop accuracy in carrying out scientific methods.

Another role is maintaining safety. The teacher is responsible for ensuring that students follow laboratory rules, wear protective gear, and use materials appropriately. This promotes a culture of safety and responsibility.

The teacher also facilitates inquiry and discovery. By posing questions and encouraging exploration, the teacher stimulates curiosity and analytical thinking, which are essential skills in scientific learning.

Finally, the teacher assesses students' practical skills. This includes evaluating how students follow procedures, make observations, and draw conclusions. Continuous assessment during practicals helps track student progress and identify areas that need reinforcement.

17. Explain six challenges faced by Biology teachers during curriculum implementation and suggest practical solutions.

One challenge is lack of adequate teaching resources. Many schools lack models, microscopes, and lab chemicals. Teachers can address this by improvising materials, using locally available items, or integrating ICT-based visual aids where possible.

Another challenge is large class sizes. Teaching practical subjects like Biology becomes difficult when too many students share limited resources. Teachers can solve this by organizing students into manageable groups and using peer-assisted learning strategies.

A third issue is insufficient time allocation. The Biology curriculum is broad, yet lesson periods may be limited. To cope, teachers should prepare efficient lesson plans, integrate topics where applicable, and prioritize essential content.

Poor student motivation is also a challenge. Some students see Biology as a difficult or boring subject. Teachers can motivate students by using real-life examples, field trips, and engaging activities that link Biology to daily life.

Language barrier is another obstacle, especially in schools where English proficiency is low. Teachers can simplify language, use bilingual instruction where allowed, and ensure key vocabulary is clearly explained and repeated.

Lastly, limited professional development affects teachers' skills. Some teachers may lack updated training on content or pedagogy. Attending workshops, forming subject panels, and self-study through NECTA reports can help improve teacher competence.

18. Discuss six principles of learner-centered teaching in Biology and how you would apply them in a Form Two class.

The first principle is active participation. In learner-centered teaching, students must be involved in the learning process. In a Form Two class, the teacher could achieve this by organizing group discussions or practical investigations where students collect and interpret data.

Second is the principle of collaboration. Learning improves when students work together. The teacher could use pair work or group projects during lessons on topics like food chains or human health, encouraging cooperation and communication.

Another principle is inquiry-based learning. Students are encouraged to ask questions, explore, and discover answers. In Form Two, the teacher could pose a problem like "Why do leaves wilt in sunlight?" and guide learners through an experiment to find the answer.

The fourth principle is relevance. Lessons should connect to students' lives and experiences. When teaching topics like nutrition, the teacher could link content to local diets and discuss common deficiencies observed in their community.

Fifth is feedback and reflection. Learners need to receive constructive feedback and reflect on their learning. The teacher can use quick assessments, followed by class discussions on correct answers, to reinforce understanding.

Lastly, differentiated instruction is essential. Learner-centered teaching considers diverse learning needs. The teacher could offer various activities—visual, verbal, and hands-on—to cater to different abilities and ensure no learner is left behind.