THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

DIPLOMA IN SECONDARY EDUCATION EXAMINATION

733/1 **BIOLOGY 1**

Time: 3 Hours **ANSWERS** **Year: 2016**

Instructions

1. This paper consists of section A, B and C.

2. Answer all questions in section A and two questions from section B and C.

1. Give the meaning of the following biological terms:

(a) A substrate

(b) Active site

(c) Activation energy

(a) A substrate:

A substrate is the molecule on which an enzyme acts, binding to its active site to undergo a chemical reaction, such as glucose in glycolysis.

(b) Active site:

The active site is the specific region on an enzyme where the substrate binds, shaped to fit the substrate precisely, facilitating the reaction.

(c) Activation energy:

Activation energy is the minimum energy required to start a chemical reaction, lowered by enzymes to speed up processes like digestion.

2. Outline three significance of stepped cell respiration.

Stepped cell respiration ensures efficient energy production, yielding up to 38 ATP per glucose through glycolysis, Krebs cycle, and electron transport chain.

It prevents energy waste, releasing ATP in controlled steps, avoiding sudden energy spikes that could harm cells.

The process allows for intermediate products, like NADH, to be used in other metabolic pathways, enhancing cellular flexibility.

3. (a) Briefly explain the term genetic counselling.

(b) Mention two uses of "DNA analysis" in criminal investigations.

(a) Briefly explain the term genetic counselling:

Genetic counselling involves advising individuals or families about the risks, nature, and management of inherited disorders, like cystic fibrosis, based on genetic testing.

(b) Mention two uses of "DNA analysis" in criminal investigations:

DNA analysis identifies suspects by matching crime scene DNA, like blood, to a suspect’s profile.

It helps exonerate the innocent by comparing DNA evidence, ensuring accurate convictions.

4. Briefly explain three harmful effects of organisms belonging to phylum Platyhelminthes to mammals.

Platyhelminthes, like tapeworms, compete for nutrients in the host's intestines, causing malnutrition in mammals like humans.

Flukes, such as liver flukes, damage organs like the liver, leading to inflammation and impaired function in cattle.

Schistosomes cause schistosomiasis, triggering fever and organ damage in humans through their life cycle in blood vessels.

5. Identify three main features to observe when selecting a quality biology textbook.

A quality biology textbook should have accurate content, ensuring scientific facts, like the structure of DNA, are correct and current.

It should include clear visuals, such as diagrams of the heart, to enhance understanding of complex concepts.

The book should align with the curriculum, covering topics like ecology and genetics as per educational standards.

6. Give three reasons why biologists use small mammals in dissection practicals.

Small mammals, like rats, are cost-effective and easier to obtain than larger animals, making them practical for classroom use.

Their anatomy, such as the digestive system, is similar to humans, providing relevant learning for biological studies.

They are easier to handle and dissect, allowing students to focus on learning techniques without logistical challenges.

7. Outline three ways of discouraging superficial learning in biology lessons.

Encourage active learning through hands-on activities, like dissecting a frog, to deepen understanding of anatomy.

Use inquiry-based questions, such as asking students to predict osmosis outcomes, to promote critical thinking.

Incorporate real-world applications, like discussing genetics in medicine, to make learning meaningful and engaging.

8. State three rationales of including assessment part in a biology lesson plan.

Assessment evaluates student understanding, ensuring concepts like photosynthesis are grasped before moving forward.

It provides feedback for teachers, highlighting areas, such as cell division, where students need more support.

Assessment motivates students, as quizzes on ecosystems encourage preparation and active participation.

9. Identify three ways in which a biology learner benefits from a well-planned lesson.

A well-planned lesson ensures clear objectives, helping students focus on mastering topics like respiration.

It includes engaging activities, such as experiments on enzyme activity, enhancing comprehension and interest.

The lesson provides structured progression, building knowledge from cell structure to genetics, avoiding confusion.

10. Give five points to support the argument that "bat is both a bird and a mammal".

This question appears to be based on a misconception, as bats are mammals, not birds. However, addressing the argument as presented:

Bats have wings, like birds, which might lead to the misconception they are birds, supporting flight.

They can fly, a trait commonly associated with birds, contributing to the confusion.

Bats are warm-blooded, a characteristic shared with both birds and mammals, adding to the debate.

However, bats nurse their young with milk, a mammalian trait, distinguishing them from birds.

Their skeletal structure, with elongated fingers supporting wings, aligns more with mammals than bird anatomy.

11. (a) (i) Explain what happens to the metabolic rate, breathing rate and heart beat in people shown in the photograph.

During physical activity such as running, the metabolic rate of the body increases significantly. This is because the muscles require more energy to sustain movement. To meet this energy demand, the cells increase the rate at which they convert glucose into energy. Consequently, the breathing rate also increases to allow more oxygen intake, which is necessary for aerobic respiration. At the same time, the heart beats faster to transport the oxygen and nutrients to the working muscles and to remove carbon dioxide and other waste products produced during the activity.

(ii) Explain why muscles of these people are going to experience anaerobic respiration.

The muscles of the people in the photograph are likely to undergo anaerobic respiration because the high intensity of running may exceed the amount of oxygen being supplied to the muscles. When the oxygen supply is insufficient for aerobic respiration, the body temporarily shifts to anaerobic respiration to continue producing energy. In anaerobic respiration, glucose is broken down without the use of oxygen, leading to the production of lactic acid. This helps in maintaining muscle activity, but the accumulation of lactic acid can cause fatigue and muscle cramps.

(b) Describe the events that may likely happen suddenly after these people have completed performing this activity.

After completing an intense physical activity like running, the body goes through a recovery process. One of the first events is heavy breathing, as the body tries to restore normal oxygen levels and repay the oxygen debt that accumulated during anaerobic respiration. The muscles may also feel tired or sore due to the accumulation of lactic acid. Additionally, the heartbeat will remain elevated for a short time before gradually returning to normal. The body will also sweat more to regulate temperature and eliminate excess heat generated during exercise. Some individuals may experience dizziness or muscle cramps as the body tries to adjust back to its resting state.

(c) In six points, differentiate between Glycolysis and Kreb's cycle pathways of respiratory reactions.

Glycolysis takes place in the cytoplasm of the cell. It is the first stage of cellular respiration and does not require oxygen, meaning it is an anaerobic process.

Kreb's cycle occurs in the mitochondria, which are specialized organelles in the cell responsible for aerobic energy production. Unlike glycolysis, the Kreb's cycle requires oxygen and is an aerobic process.

During glycolysis, one molecule of glucose is broken down into two molecules of pyruvate, producing a small amount of energy in the form of ATP and high-energy molecules like NADH.

In the Kreb's cycle, the pyruvate produced from glycolysis is further broken down into carbon dioxide and water. This process releases more energy in the form of ATP and also produces NADH and $FADH_2$ which are essential for the electron transport chain.

Glycolysis produces a net gain of 2 ATP molecules per glucose molecule, while the Kreb's cycle contributes to a larger overall ATP yield when its products enter the electron transport chain.

Glycolysis is a common pathway for both aerobic and anaerobic respiration, while the Kreb's cycle is only involved in aerobic respiration and cannot occur in the absence of oxygen.

12. Analyze three mutagenic agents which cause mutation in organisms.

Radiation is one of the primary mutagenic agents that causes mutations in organisms. Ionizing radiation such as X-rays, gamma rays, and ultraviolet (UV) rays have high energy levels that can penetrate cells and damage the DNA structure. This damage can result in changes in the sequence of nucleotides, leading to gene mutations, chromosomal aberrations, or even cancerous growths.

Chemical agents are another major cause of mutations. Certain chemicals such as mustard gas, nitrosamines, and benzene can interfere with the normal base pairing of DNA or cause chemical alterations in nucleotide structures. These alterations can lead to incorrect replication of DNA during cell division, thereby introducing permanent changes in the genetic code of the organism.

Biological agents also contribute to mutations in living organisms. Some viruses, especially retroviruses, can insert their genetic material into the host genome, disrupting normal gene function. Additionally, transposons or "jumping genes" can move from one location in the genome to another, altering gene expression and causing mutations that can be passed to the next generation.

13. With examples, explain four areas where genetic engineering is applied.

In agriculture, genetic engineering is widely applied to create genetically modified crops that are resistant to pests, diseases, or harsh environmental conditions. For example, Bt cotton is genetically modified to produce toxins that kill pests, reducing the need for chemical pesticides and increasing crop yields.

In medicine, genetic engineering is used to produce pharmaceutical products such as insulin, growth hormones, and vaccines. By inserting human genes into bacteria or yeast cells, scientists can produce large quantities of these essential medicines quickly and cost-effectively.

In industrial processes, genetic engineering enables the production of enzymes that enhance manufacturing efficiency. For example, genetically engineered microbes are used to produce enzymes for food processing, biofuel production, and textile manufacturing, leading to cost-effective and environmentally friendly solutions.

In environmental protection, genetic engineering is used to develop organisms that can clean up environmental pollutants through a process called bioremediation. Genetically modified bacteria, for instance, can break down oil spills or detoxify hazardous waste, helping to maintain ecological balance.

14. (a) By giving five reasons, justify the statement that "class Insecta is highly successful among arthropods."

Insects exhibit high reproductive rates which allow them to multiply rapidly and maintain large populations. This high rate of reproduction ensures survival even under adverse conditions and increases the chances of species continuity.

Insects have the ability to adapt to various environmental conditions. They can live in deserts, forests, freshwater bodies, and even inside human settlements. This ecological adaptability contributes significantly to their success.

Flight is a unique advantage for many insects. Wings provide mobility, allowing insects to escape predators, migrate to new habitats, and locate food or mates efficiently. This has contributed to their wide distribution and evolutionary success.

Insects possess specialized feeding structures adapted for different diets. Some have piercing-sucking mouthparts, others have chewing or siphoning parts, which enable them to exploit a wide range of food resources and ecological niches.

Insects undergo metamorphosis, which allows different stages of their life cycle to occupy different habitats and utilize different food sources. This reduces competition within the species and increases survival rates.

(b) Explain five economic importance of class Insecta.

Insects are essential for pollination of crops such as fruits, vegetables, and flowers. This natural pollination service increases agricultural productivity and contributes to food security and biodiversity.

Some insects act as natural pest controllers by feeding on harmful pests. For instance, ladybirds feed on aphids, helping farmers reduce the need for chemical pesticides and promoting organic farming practices.

Insects such as bees and silkworms are sources of economically valuable products like honey, beeswax, and silk. These products have significant commercial value and support various industries.

Insects contribute to the decomposition of organic matter and nutrient recycling. Dung beetles and other decomposers help in breaking down animal waste and dead plant material, enriching the soil and promoting healthy ecosystems.

Certain insects are used as food in some cultures and serve as a protein source. Edible insects such as grasshoppers and crickets are rich in nutrients and are considered sustainable food alternatives.

15. Discuss six principles of teaching and learning Biology.

The principle of learner-centeredness emphasizes that the teaching of biology should focus on the needs, interests, and experiences of the learners. This involves engaging students actively in the learning process through interactive methods such as discussions, experiments, and projects that make the content more relevant and meaningful.

The principle of activity-based learning involves using practical experiences such as laboratory experiments, fieldwork, and model demonstrations. Biology, being a science subject, becomes more understandable and interesting when students interact with real-life specimens and perform activities that reinforce theoretical concepts.

The principle of integration stresses the need to connect biological concepts with real-life situations and other subjects. This helps students to appreciate the relevance of biology in solving day-to-day problems and also strengthens their overall understanding through interdisciplinary learning.

The principle of progression and continuity requires that the biology curriculum be organized in a logical sequence where simple concepts are taught before complex ones. This ensures that students build on their prior knowledge and experience a smooth transition from basic to advanced topics.

The principle of reinforcement involves the regular revision of previously taught content to ensure retention. Teachers should provide continuous practice, assignments, and feedback so that students can consolidate their learning and correct any misconceptions early.

The principle of evaluation emphasizes the importance of assessing students' understanding regularly. Evaluation may be done through tests, quizzes, practicals, and observation. It helps the teacher to monitor progress and plan remedial measures for students who are lagging behind.

16. As a biology expert, you have been invited to advise the school committee on construction of a biology laboratory to a newly built school.

(a) Describe five basic plans for a typical biology laboratory.

A biology laboratory should have proper ventilation and lighting to provide a conducive learning environment and reduce exposure to harmful chemicals and gases. Adequate natural light and airflow also enhance visibility and comfort during practical sessions.

The laboratory must be equipped with a constant water supply and multiple sinks for cleaning apparatus and washing hands. This facilitates hygienic practices and supports experiments that require water.

There should be strong, spacious workbenches with gas and electric outlets. These benches provide space for practical work while the power and gas supplies are necessary for heating and using electrical laboratory equipment such as microscopes.

The laboratory must include storage facilities for chemicals, specimens, glassware, and models. Properly labeled cabinets and shelves help in maintaining order and ensuring the safety of fragile and hazardous materials.

Safety features such as fire extinguishers, first aid kits, emergency exits, and eye wash stations must be included in the plan. These safety measures protect both students and teachers from laboratory accidents and emergencies.

(b) Elaborate four guidelines to be followed when ordering materials for the laboratory use.

Teachers should consider the curriculum requirements before ordering materials. The materials should align with the topics to be covered so that students can perform relevant experiments and practical work.

The safety and quality of the materials should be prioritized. Only high-standard chemicals and apparatus should be purchased to ensure student safety and accurate results during experiments.

All materials should be properly labeled and organized upon delivery. This helps in easy identification and storage, and reduces the chances of confusion and mishandling.

Budget considerations should also guide the ordering process. Teachers should compare prices from different suppliers and select quality materials that fit within the school's financial limits without compromising on learning objectives.

17. Explain six merits and three demerits of an open-ended test question to biology teachers and students.

One merit of open-ended questions is that they promote critical thinking. Students are required to analyze, evaluate, and synthesize information instead of merely recalling facts, which deepens their understanding of biology concepts.

Open-ended questions also allow students to express their ideas freely and creatively. This helps teachers to identify individual learning styles and areas of strength, making it easier to provide personalized support.

Such questions assess a wider range of cognitive skills, including application, analysis, and evaluation. This provides a more comprehensive understanding of the learner's capabilities.

They encourage research and independent thinking. Students who are required to write detailed answers often look for additional sources, which expands their knowledge base beyond the classroom content.

Open-ended questions reduce the chances of guesswork, unlike multiple-choice questions. This makes assessment more reliable, as students must demonstrate genuine knowledge.

For teachers, open-ended questions are useful in evaluating higher-order thinking skills and understanding the depth of students' learning. They help teachers identify gaps in teaching and make necessary adjustments.

However, open-ended test questions have some demerits. One of them is that they are time-consuming for students to answer and for teachers to mark, especially when dealing with large numbers of students.

They may lead to subjective marking. Since responses vary in structure and depth, different teachers may assign different scores for similar content, leading to inconsistency.

Open-ended questions may demotivate weaker students who struggle to organize their thoughts or write detailed answers. This can affect their performance and self-confidence.

18. (a) Block teaching is very important to a teacher trainee. Discuss by giving seven points.

Block teaching provides teacher trainees with an extended period of real classroom experience. It allows them to apply theoretical knowledge in a practical setting and improve their instructional techniques through continuous practice.

It helps to build confidence in teacher trainees. As they conduct lessons regularly, they become more comfortable with classroom interactions, content delivery, and managing students.

Block teaching allows trainees to engage in full lesson planning and implementation. This strengthens their ability to prepare schemes of work, lesson plans, and teaching aids systematically.

The experience of teaching over a continuous period helps trainees to understand classroom dynamics. They learn how to manage diverse learners, deal with discipline issues, and maintain an effective learning environment.

Trainees receive continuous feedback and supervision from mentors during block teaching. This helps them identify their strengths and weaknesses and improve their professional skills progressively.

Block teaching exposes trainees to real assessment methods. They learn to prepare and administer tests, mark assignments, and evaluate learners' performance effectively.

It promotes professional growth and commitment. Being part of a school environment allows trainees to develop good work ethics, communication skills, and a better understanding of their future role as teachers.

(b) Explain two limitations of each of the following types of teaching practice:

(i) Single lesson practice has limited exposure to teaching challenges. The trainee only teaches for a short time, which may not reflect the real teaching experience and classroom difficulties.

Another limitation of single lesson practice is the lack of continuity in assessment. One lesson may not provide enough data to evaluate the teaching skills and progress of the trainee effectively.

(ii) Block teaching practice can be time-consuming and may interfere with other academic activities of the trainee. Extended teaching schedules can affect their personal study time and cause fatigue.

Another limitation is that block teaching may lead to physical and mental exhaustion. The demands of prolonged teaching without sufficient rest may affect the performance and enthusiasm of the trainee.