THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

DIPLOMA IN SECONDARY EDUCATION EXAMINATION

733/1 **BIOLOGY 1**

Time: 3 Hours **ANSWERS** **Year: 2014**

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. Describe briefly Zwitterions formation in amino acids.

A zwitterion is a molecule that contains both a positive and a negative charge but remains overall electrically neutral. In amino acids, zwitterion formation occurs when the amino group ($–NH_2$) accepts a hydrogen ion (H^+) to become $–NH_3^+$, while the carboxyl group (–COOH) donates a hydrogen ion to become $–COO^–$. This typically happens in aqueous solutions at a specific pH known as the isoelectric point. The amino acid, therefore, exists with a positively charged amino end and a negatively charged carboxyl end, forming a zwitterion.

2. State where the following processes occur in a living cell:

(a) Glycolysis occurs in the cytoplasm of the cell. This is the initial stage of cellular respiration where glucose is broken down into pyruvate, producing ATP and NADH.

(b) Kreb's cycle takes place in the mitochondria. It is the second stage of aerobic respiration, where acetyl-CoA is oxidized to carbon dioxide and high-energy carriers such as NADH and $FADH_2$ are produced.

(c) Oxidative phosphorylation occurs in the inner mitochondrial membrane. It involves the electron transport chain and chemiosmosis, which lead to the production of a large amount of ATP by transferring electrons through a series of proteins and pumping protons to generate a gradient.

3. Differentiate between Ribonucleic acid (RNA) and Deoxyribonucleic acid (DNA).

RNA contains the sugar ribose, while DNA contains the sugar deoxyribose, which lacks one oxygen atom. RNA is usually single-stranded, whereas DNA is double-stranded and forms a double helix structure. In RNA, the nitrogenous base uracil replaces thymine, which is present in DNA. Functionally, RNA is involved in protein synthesis and gene expression, while DNA stores genetic information and carries hereditary material in cells.

4. Outline three factors that may lower body immunity.

Poor nutrition, especially deficiencies in essential vitamins and minerals such as vitamin C, zinc, and iron, can weaken the immune system and lower the body's ability to fight infections.

Chronic stress reduces immune function by increasing the levels of cortisol, a hormone that suppresses the activity of immune cells, making the body more susceptible to diseases.

Lack of proper sleep also lowers immunity. Inadequate rest affects the production of cytokines, which are proteins vital for immune responses, and reduces the efficiency of immune cells.

5. Explain briefly how energy is lost in the ecosystem from one trophic level to another.

Energy is lost in the ecosystem as it moves from one trophic level to another due to several reasons. A large portion of energy is used by organisms for metabolic processes such as respiration, movement, and reproduction. Some energy is lost as heat during these activities. Additionally, not all parts of organisms are consumed or digested by predators, such as bones, fur, or shells, and some energy is lost through excretion. Consequently, only about 10% of energy is passed on to the next level, following the 10% rule in energy transfer.

6. State how the members of the class Osteichthyes differ from the members of the class Chondrichthyes.

Members of the class Osteichthyes, or bony fish, have a skeleton made of bone, whereas Chondrichthyes, or cartilaginous fish, have skeletons made of cartilage. Osteichthyes have an operculum covering the gills, allowing them to breathe without moving, while Chondrichthyes lack an operculum and must keep moving to force water over their gills. Osteichthyes have swim bladders for buoyancy, but Chondrichthyes rely on their oily liver and continuous movement for buoyancy. Their scales also differ, with bony fish having cycloid or ctenoid scales, and cartilaginous fish having placoid scales.

7. Describe briefly any three objectives of learning Biology Pedagogy for a student teacher.

One objective is to equip student teachers with knowledge of effective teaching methods and strategies specific to biology. This helps them plan and deliver lessons that cater to students' learning needs.

Another objective is to help student teachers understand how to use laboratory equipment and conduct biology practicals safely and effectively. This is crucial for engaging learners and reinforcing theoretical knowledge.

A third objective is to develop skills in assessing and evaluating students' performance in biology. This includes designing tests, interpreting results, and using feedback to improve teaching and learning outcomes.

8. Identify importance of organizing laboratory apparatus and chemicals.

Organizing laboratory apparatus and chemicals ensures safety by preventing accidents such as spills, breakage, or chemical reactions caused by improper storage. It also increases efficiency during practical sessions, as students and teachers can easily access the required materials. Moreover, proper organization facilitates inventory management and helps in maintaining hygiene and cleanliness in the laboratory environment.

9. Why are Biology teachers urged to standardize test/examination scores?

Standardizing test scores ensures fairness and consistency in student assessment. It allows for uniform interpretation of results across different classes or schools. It also helps in identifying areas where students struggle, thereby guiding remedial teaching. Standardization also supports academic benchmarking and improves the credibility of examinations.

10. Give three factors that may affect validity of a Biology test.

Poorly constructed test items that do not reflect the objectives of the subject can reduce the validity of the test. Questions must align with what was taught and intended to be assessed.

If the test lacks content coverage, meaning it does not adequately sample the biology syllabus, the results may not accurately reflect students' knowledge or abilities.

Time allocation can also affect validity. If the test is either too short or too long, students may not demonstrate their full potential, and this leads to inaccurate assessment outcomes.

11. With support of a diagram describe the main stages of glycolysis which lead to release of energy from one molecule of glucose.

Glycolysis is the first stage of cellular respiration and occurs in the cytoplasm. It involves the breakdown of one molecule of glucose (6-carbon) into two molecules of pyruvate (3-carbon). The stages include:

- Glucose is phosphorylated using two ATP molecules to form fructose-1,6-bisphosphate.
- The fructose molecule is split into two 3-carbon molecules: glyceraldehyde-3-phosphate (G3P).
- Each G3P undergoes oxidation and phosphorylation, producing NADH and ATP.
- Eventually, two molecules of pyruvate are formed, yielding a net gain of two ATP and two NADH molecules.

(A clear diagram of glycolysis stages should accompany this explanation, showing input of ATP, conversion of intermediates, and output products.)

12. (a) Using cross diagrams, predict the possible blood groups of children sired from a man of blood group A and a woman of blood group AB.

Possible combinations:
Father genotype: AA or Ai
Mother genotype: AB

Crossing AA × AB yields: AA, AB
Children may have blood groups A and AB

Crossing Ai × AB yields: AA, AB, Ai, Bi
Children may have blood groups A, B, AB

(b) Using a punnet square, work out possible phenotypes of offspring if a carrier woman with XHXh married a haemophilic male XhY.

	XH	Xh
Xh	XHXh	XhXh
Y	XHY	XhY

Phenotypes:
- Females: 50% carriers (XHXh), 50% haemophilic (XhXh)
- Males: 50% normal (XHY), 50% haemophilic (XhY)

(c) Explain why:

(i) There are no carrier males.

Males inherit only one X chromosome. If that X carries the haemophilic gene, the male will express the disease. There is no second X to mask the effect, so males can only be normal or haemophilic but never carriers.

(ii) Some of the females are healthy although they carry the defective gene.

Females have two X chromosomes. If one carries the defective gene (Xh) and the other is normal (XH), the normal gene masks the defective one. Hence, such females are carriers but do not show symptoms of haemophilia.

13. (a) With examples, categorize human diseases basing on their origin/nature.

Human diseases can be categorized into infectious and non-infectious diseases. Infectious diseases are caused by pathogenic microorganisms such as bacteria, viruses, fungi, and protozoa. Examples include tuberculosis (caused by bacteria), malaria (caused by protozoa), and influenza (caused by viruses). These diseases can be transmitted from one person to another either directly or indirectly.

Non-infectious diseases are not caused by pathogens and are not transmissible. They may be caused by genetic disorders, lifestyle factors, or environmental influences. Examples include diabetes (metabolic disorder), hypertension (lifestyle disease), and sickle cell anemia (genetic disorder).

(b) Suggest five preventive measures against HIV and AIDS.

One preventive measure is the use of condoms during sexual intercourse. This barrier method significantly reduces the risk of HIV transmission through sexual contact.

Another preventive measure is abstinence from sexual activities, particularly for individuals who are not in a monogamous relationship. Abstinence completely eliminates the risk of sexually transmitted HIV.

Screening blood before transfusion is crucial. Ensuring that blood and blood products are free from HIV prevents transmission during medical procedures.

Avoiding the sharing of sharp objects such as needles, razors, and syringes is important, as these can transmit HIV if contaminated with infected blood.

Public education and awareness campaigns help people understand HIV transmission routes, adopt safe practices, and reduce stigma, encouraging more people to get tested and seek treatment.

14. With support of illustrations, analyze the factors affecting the rate of enzymatic reaction.

The temperature significantly affects the rate of enzymatic reactions. As temperature increases, enzyme activity also increases up to an optimum point. Beyond this point, enzymes denature and lose functionality. For example, human enzymes work best at around 37°C.

pH also influences enzyme activity. Each enzyme works best at a specific pH. Extreme acidic or basic conditions can alter enzyme structure and reduce activity. For instance, pepsin works well in acidic pH while amylase works best in neutral pH.

The concentration of substrate affects enzyme reaction rate. As substrate concentration increases, the rate of reaction increases until all enzyme active sites are occupied. Beyond that point, adding more substrate does not increase the rate.

Enzyme concentration also influences the reaction. A higher concentration of enzymes increases the number of active sites, thus increasing the rate of reaction if substrate is available in excess.

The presence of inhibitors affects enzyme activity. Competitive inhibitors bind to the active site and prevent substrate binding, reducing the reaction rate. Non-competitive inhibitors bind elsewhere and alter the enzyme's shape, also decreasing activity.

Illustrations should include a graph showing the effect of temperature and pH on enzyme activity and diagrams showing substrate-enzyme binding and inhibition types.

15. (a) If you were to draw a Biological diagram on a manila sheet, what considerations could you take so as to make your diagram a good and effective teaching aid.

The diagram should be large and clearly visible to all students in the class. This ensures everyone can follow the lesson without straining their vision.

It should be accurately labeled with neat and legible writing. Labels should be placed horizontally using straight lines to enhance clarity and understanding.

The diagram must be scientifically accurate, representing the correct structure, shape, and proportion of biological components. Misleading illustrations can confuse students.

It should be simple and free from unnecessary artistic details. The aim is to teach biology concepts, not to decorate.

Use of color coding can improve visibility and highlight important parts, but it must be consistent and purposeful to avoid confusion.

(b) Comment on the statement that "improvisation of biological teaching and learning resources is essential".

Improvisation helps to overcome the lack of standard teaching materials. In many schools, especially in resource-limited settings, teachers may not have access to expensive models or equipment, so creating teaching aids from locally available materials becomes necessary.

It encourages creativity among teachers and students. Teachers develop innovative ways to explain concepts using everyday materials, making learning more engaging.

Improvised materials are cost-effective and sustainable. They reduce dependency on imported or commercial resources and encourage the use of recyclable materials.

Improvisation enhances learner participation. Students can be involved in making models and aids, which helps them understand concepts better and develop practical skills.

It ensures continuity in teaching. Even when standard materials are not available, lessons can still proceed effectively using improvised alternatives.

(c) Suppose you are planning for microteaching, what considerations would you put forward during preparation?

I would clearly define the lesson objectives to ensure focus and relevance. Objectives help in determining the content and teaching methods to be used.

I would prepare a detailed lesson plan with all necessary components including introduction, lesson development, and conclusion. This structure guides the teaching process effectively.

I would select appropriate teaching methods suitable for the microteaching session, such as demonstration or questioning techniques, based on the topic and learner level.

I would gather and prepare the necessary teaching aids in advance. These aids help in illustrating concepts and maintaining learner attention during the session.

I would plan assessment tools to evaluate the effectiveness of the lesson. This could include oral questions or short written tasks.

I would ensure proper classroom organization and time management to utilize the limited time effectively and avoid disruptions during the session.

16. (a) Recommend two assessment tools in Biology other than tests and examinations and elaborate four advantages for each.

One assessment tool is project work. Projects involve students in research and problem-solving activities. They promote creativity, develop investigative skills, and provide long-term understanding of concepts. Projects encourage teamwork and improve learners' planning and time management skills.

Another tool is practical work assessment. This involves evaluating students during laboratory activities. It enhances hands-on skills, promotes the application of theoretical knowledge, and builds interest in scientific inquiry. Practical assessments provide immediate feedback on students' strengths and areas needing improvement.

(b) Explain six importance of giving tests to students in teaching and learning Biology.

Tests help in evaluating students' understanding of biology concepts. They show whether learning objectives have been achieved and highlight areas requiring revision.

They help teachers to monitor students' academic progress. Regular testing reveals trends in performance and identifies students needing remedial support.

Tests motivate students to study consistently and prepare well. Knowing they will be assessed encourages discipline and time management.

They help in curriculum planning. Teachers can use test results to adjust content coverage, teaching strategies, and lesson pacing.

Tests prepare students for national examinations by familiarizing them with question formats and improving their confidence in handling exam papers.

They serve as feedback tools for both teachers and learners. Teachers improve instruction based on test outcomes, while students learn from their mistakes and work on improvement.

17. Ms Makini has covered the following sub-topics on "Gaseous exchange and respiration" to a Form Two class:

(i) Construct a Table of Specification based on all levels of cognitive domain. The total number of questions should be 20.

A Table of Specification distributes questions based on Bloom's Taxonomy cognitive levels (Knowledge, Comprehension, Application, Analysis, Synthesis, Evaluation). For 20 questions, the table might allocate:
- Knowledge: 5 questions
- Comprehension: 5 questions
- Application: 4 questions
- Analysis: 3 questions
- Synthesis: 2 questions
- Evaluation: 1 question

Each sub-topic (concept of gaseous exchange, gaseous exchange in animals, plants, and aerobic respiration) should be represented across these levels.

(ii) Explain the procedures you have used to construct the Table of Specification in (a) above.

The first procedure is identifying the sub-topics to be assessed. Each sub-topic must have a fair representation in the table.

Next is determining the number of questions per cognitive level based on curriculum objectives and time available.

Then, allocate questions across topics and cognitive levels according to their weight and learning importance.

After that, ensure the questions are balanced and relevant, matching the learning objectives of each topic.

Finally, review the table to confirm accuracy and fairness, ensuring it reflects the intended learning outcomes and assessment standards.

18. (a) With the aid of diagrams, explain the following Biological terminologies:

(i) Longitudinal section refers to a vertical cut along the length of a structure. It shows the internal structure from top to bottom. For example, a longitudinal section of a root shows xylem and phloem arrangement in detail.

(ii) Transverse section refers to a horizontal cut across a structure. It shows the cross-sectional view. A transverse section of a stem shows vascular bundles, cortex, and epidermis in circular patterns.

(b) Describe how you would guide your students to perform the following:

(i) Making dissection of a cockroach involves first anesthetizing the insect, then placing it dorsal side up on a dissection board. Students should make a mid-dorsal incision using dissection scissors and expose internal organs such as digestive, reproductive, and respiratory systems, identifying each part clearly.

(ii) Preparation of a section of a fresh onion bulb involves peeling a thin layer of epidermis from the inner side of an onion bulb scale. The layer is placed on a microscope slide, stained with iodine, covered with a cover slip, and observed under a microscope. Students identify cell wall, nucleus, and cytoplasm.