THE UNINTED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION AND CULTURE

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

133/1 **BIOLOGY 1**

Time: 2:30 Hours **ANSWERS** **Year: 2008.**

Instructios:

1. this paper consists of eleven questions
2. answer all questions in section A, and three questions in section B.
3. the marks allocation is indicated at the beginning of each section.

1. Study the molecular structure below and answer the questions that follow.

(a) (i) Write the general name of the structural formula shown above.
The general name of the structural formula shown above is an amino acid.

(ii) What is the simplest form of R?
The simplest form of R is a hydrogen atom (H), which corresponds to the amino acid glycine.

(iii) Which part of the structure gives acidic properties of the molecule?
The acidic properties come from the carboxyl group (-COOH).

(iv) Which part of the structure gives basic properties of the molecule?
The basic properties are due to the amino group (-NH2).

(b) Two molecules of the above structure may join to produce a compound.

(i) Illustrate the compound produced.
The compound formed is a dipeptide, where the carboxyl group of one amino acid binds with the amino group of another amino acid through a condensation reaction, forming a peptide bond.

(ii) What name is given to the type of bond formed in the joining of the two molecules?
The bond formed is called a peptide bond.

2. (a) Give the differences between the skeleton of arthropods and that of a mammal.
i. Arthropods have an exoskeleton made of chitin, while mammals have an internal endoskeleton made of bones and cartilage.
ii. The exoskeleton in arthropods provides external protection and limits growth, whereas the endoskeleton in mammals supports body structure and facilitates growth without molting.

(b) What characteristic features do fish and mammals have in common?

i. Both fish and mammals have a vertebral column, which is part of their internal skeleton.
ii. Both possess a closed circulatory system with a heart for blood circulation.

3. Giving two examples, explain how synthetic hormones are used in:

(a) Animal husbandry.
Synthetic hormones like oxytocin are used in animal husbandry to enhance milk production in dairy animals and improve reproductive efficiency by stimulating ovulation.

(b) Crop production.
In crop production, synthetic hormones such as gibberellins are applied to promote stem elongation, delay fruit aging, and enhance seed germination.

(c) Improvement of livelihood.
Synthetic hormones improve livelihoods by increasing agricultural and livestock productivity, which leads to higher income and better food security for farmers and communities.

4. The amount of DNA per cell during several nuclear divisions is represented in figure 1.

(a) Which type of nuclear division is represented by figure 1?
The type of nuclear division represented by figure 1 is meiosis.

(b) What phases are represented by the dashed lines W, X, and Y?
i. W represents the S-phase (synthesis phase) during interphase where DNA replication occurs.
ii. X represents the reduction division (meiosis I), during which homologous chromosomes separate, halving the DNA content.
iii. Y represents meiosis II, where sister chromatids separate, leading to the formation of haploid cells.

(c) What type of cells are represented by line Z?
The cells represented by line Z are haploid gametes.

5. What would happen if detritus feeders and decomposers were to disappear from the surface of the earth?
i. Accumulation of organic waste and dead organisms would occur, leading to environmental pollution.
ii. Nutrient recycling in ecosystems would halt, disrupting soil fertility and plant growth.
iii. Energy flow in the ecosystem would be affected, causing a collapse in food chains.
iv. Carbon and nitrogen cycles would be disrupted, leading to imbalances in atmospheric gases.
v. Habitats for certain microorganisms dependent on decomposition would be lost, affecting biodiversity.
vi. Overall ecosystem functioning and sustainability would degrade severely.

6. (a) Why are the reaction centers of photosystems I and II referred to as P.700 and P.680, respectively?
Photosystem I has a reaction center with a peak absorption at 700 nm, hence called P.700. Photosystem II has a reaction center with a peak absorption at 680 nm, hence called P.680.

(b) Compare cyclic and non-cyclic photophosphorylation.
i. In cyclic photophosphorylation, electrons released from chlorophyll return to the same chlorophyll molecule, whereas in non-cyclic photophosphorylation, electrons do not return and are transferred to NADP+ to form NADPH.

ii. Cyclic photophosphorylation generates only ATP, while non-cyclic photophosphorylation generates both ATP and NADPH.

iii. Cyclic photophosphorylation involves only photosystem I, while non-cyclic photophosphorylation involves both photosystem I and photosystem II.

iv. Non-cyclic photophosphorylation leads to photolysis of water, producing oxygen as a byproduct, while cyclic photophosphorylation does not involve photolysis.

7. Explain the meaning of the following statements:

(a) Nerve impulse obeys the "all-or-nothing" principle.
This principle states that a nerve impulse is either fully triggered or not at all, depending on whether the stimulus reaches the threshold level. If the threshold is reached, a full action potential is generated; if not, no action potential occurs.

(b) Plant growth substances are frequently having antagonism and synergism interaction to each other.
Antagonism occurs when one plant hormone counteracts the effects of another, such as auxins inhibiting cytokinin-induced cell division. Synergism occurs when two hormones work together to enhance a physiological response, such as auxins and gibberellins promoting stem elongation.

8. (a) Outline the transport mechanism involved in the exchange of substances between mother and fetus in humans.
i. The placenta serves as the site for exchange, allowing diffusion of oxygen and nutrients from maternal blood to fetal blood.
ii. Waste products like carbon dioxide and urea from the fetus diffuse back into the maternal blood.
iii. Active transport mechanisms are involved in transferring ions like calcium and iron from the mother to the fetus.
iv. Facilitated diffusion helps transport glucose to the fetus via specific carrier proteins.

(b) Using examples, explain two advantages of a closed double circulatory system.
i. Efficient oxygenation: Blood is pumped at high pressure through the body, ensuring rapid and efficient delivery of oxygen to tissues, as seen in mammals.
ii. Separation of oxygenated and deoxygenated blood: This allows the heart to pump oxygen-rich blood specifically to body tissues and oxygen-poor blood to the lungs, improving metabolic efficiency.

9. (a) Give an account for the large difference in daily energy requirements of a large mammal e.g., human and a small mammal (mouse) on a weight-for-weight basis.
The difference in daily energy requirements is primarily due to the surface area-to-volume ratio. Smaller mammals, like mice, have a larger surface area relative to their volume, which causes rapid heat loss to the environment. To maintain their body temperature, they require higher metabolic rates and energy consumption. On the other hand, larger mammals like humans have a smaller surface area relative to their volume, reducing heat loss and requiring less energy per unit of weight for thermoregulation. Furthermore, the activity levels and dietary habits also contribute to the differences in energy requirements.

(b) Giving examples for each, differentiate between endothermic and ectothermic organisms.
i. Endothermic organisms regulate their body temperature internally through metabolic processes. For example, mammals and birds are endothermic as they maintain constant body temperatures regardless of the external environment.
ii. Ectothermic organisms rely on external environmental conditions to regulate their body temperature. Examples include reptiles and amphibians, which bask in the sun to raise their body temperature and seek shade to cool down.

10. (a) Define the term meristem.
A meristem is a region of actively dividing cells in plants responsible for growth and development. These cells are undifferentiated and have the potential to differentiate into various specialized tissues.

(b) Write short notes on lateral meristems with reference to location, role, and effect.
Lateral meristems are located along the sides of stems and roots, primarily in woody plants. They consist of the vascular cambium and cork cambium. The vascular cambium is responsible for secondary growth, producing xylem and phloem tissues, which increase the thickness of stems and roots. The cork cambium generates protective outer layers, such as bark, which prevent water loss and protect against mechanical damage. The activity of lateral meristems results in the widening of plant structures, allowing them to support larger structures and conduct more water and nutrients.

11. (a) The father is blood group A and the mother blood group B. Explain, using appropriate genetic symbols, the possible blood groups of their children.
The ABO blood group system involves three alleles: IA, IB, and i. The father with blood group A can have a genotype of either IAIA or IAi, while the mother with blood group B can have a genotype of either IBIB or IBi. The possible combinations are:
- IAIB: Blood group AB.
- IAi: Blood group A.
- IBi: Blood group B.
- ii: Blood group O.
Thus, the children can have blood groups A, B, AB, or O.

(b) If these parents get non-identical twins, what is the probability that both twins have blood group A?
The probability of one child having blood group A is 25%. For non-identical twins, the probability that both have blood group A is:
$0.25 \times 0.25 = 0.0625$ or 6.25%.

12. (a) Write three differences between nervous and endocrine coordination.
i. Nervous coordination involves the transmission of electrical impulses through neurons, whereas endocrine coordination involves the secretion of hormones into the bloodstream.
ii. Nervous responses are fast and short-lived, while endocrine responses are slower but longer-lasting.
iii. Nervous coordination is localized to specific target cells, whereas endocrine coordination has widespread effects on different tissues.

(b) (i) Explain briefly how the eustachian tube of the human ear works in relation to pressure.
The eustachian tube connects the middle ear to the nasopharynx and helps equalize air pressure on both sides of the eardrum. This prevents discomfort and maintains proper hearing function.

(ii) Account for the discomfort and deafness that may occur during aeroplane take-off and deep diving.

During rapid altitude changes, the air pressure outside the ear changes faster than the pressure in the middle ear. If the eustachian tube cannot equalize the pressure promptly, it can cause discomfort, pain, and temporary hearing loss. Similar effects occur during deep diving due to increased water pressure.

13. (a) Explain briefly the meaning of the following terms:

(i) Tactic movements.
Tactic movements are directional movements of organisms or cells in response to external stimuli such as light or chemicals, for example, phototaxis in algae.

(ii) Nastic movements.
Nastic movements are non-directional responses to stimuli, depending on the intensity rather than the direction of the stimulus. For example, the closing of Mimosa pudica leaves when touched.

(b) With reference to three examples, explain how each type of movement mentioned in 13(a) above occurs in plants.
i. Tactic movement: Positive phototaxis occurs in algae as they move towards light for photosynthesis.
ii. Nastic movement: Thigmonasty occurs in Mimosa pudica, where leaves close upon touch due to rapid loss of turgor pressure.
iii. Phototropism: This is a nastic-like response where plant stems grow towards light due to unequal cell elongation regulated by auxins.

14. Identify and describe the vascular tissues in plants and explain how they are adapted to their functions.

Vascular tissues in plants are specialized tissues responsible for the transport of water, nutrients, and food. The two main vascular tissues are xylem and phloem.

i. Xylem: This tissue is responsible for the transport of water and mineral ions from the roots to other parts of the plant. It consists of tracheids, vessel elements, xylem fibers, and xylem parenchyma. Xylem is adapted to its function by having hollow, lignified tubes that reduce resistance to water flow and provide structural support to the plant. The presence of pits allows lateral movement of water between vessels.

ii. Phloem: This tissue transports organic nutrients, primarily sugars, from the leaves (where they are synthesized) to other parts of the plant for storage or immediate use. Phloem consists of sieve tube elements, companion cells, phloem fibers, and phloem parenchyma. It is adapted to its function through sieve plates that allow the flow of nutrients and companion cells that regulate the transport process by providing ATP and metabolic support.

15. (a) Define each of the following terms as applied in genetics.

(i) Gene as a functional unit.
A gene is a segment of DNA that encodes the information required for the synthesis of a specific protein or functional RNA. It is the basic unit of heredity and determines specific traits in an organism.

(ii) Genotype.
Genotype refers to the genetic constitution of an organism, represented by the alleles it inherits from its parents. For example, a genotype for blood group can be IAIA or IAi.

(iii) Phenotype.
Phenotype is the observable physical or biochemical characteristics of an organism, resulting from the interaction between its genotype and the environment. For example, the blood group (A, B, AB, or O) is a phenotype.

(b) There was a dispute (a quarrel) in a certain family. Both parents had wrinkled hair, but one of their children had straight hair. How could you assist the parents in solving the dispute?

To resolve the dispute, the inheritance of hair texture can be explained using a genetic cross.
- Let the allele for wrinkled hair be W (dominant) and the allele for straight hair be w (recessive).
If both parents have wrinkled hair but one of their children has straight hair, it implies that both parents are heterozygous for the trait (Ww). A Punnett square can help us visualize this:

Parent Genotypes:
Father: Ww
Mother: Ww
Punnett Square:

	W (Father)	**w** (Father)
W (Mother)	WW (Wrinkled)	Ww (Wrinkled)
w (Mother)	Ww (Wrinkled)	ww (Straight)

Results:
WW: Wrinkled hair (25%)
Ww: Wrinkled hair (50%)
ww: Straight hair (25%)

Conclusion:
From the cross, there is a 25% probability of having a child with straight hair (ww) even though both parents have wrinkled hair (Ww). This explains that it is genetically possible for the child to inherit straight hair if they receive the w allele from both parents.