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: 2017**

Instructions:

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

1. (a) Classify the following organisms to class level:

i. Bean:
- Kingdom: Plantae
- Phylum: Magnoliophyta (Angiosperms)
- Class: Magnoliopsida (Dicotyledonae)

ii. Crab:
- Kingdom: Animalia
- Phylum: Arthropoda
- Class: Malacostraca

iii. Elephant grass:
- Kingdom: Plantae
- Phylum: Magnoliophyta (Angiosperms)
- Class: Liliopsida (Monocotyledonae)

iv. Mouse:
- Kingdom: Animalia
- Phylum: Chordata
- Class: Mammalia

(b) Giving six reasons, justify the:

i. Phylum to which mouse belongs.
The mouse belongs to the phylum Chordata due to the following reasons:
- Presence of a notochord during embryonic development.
- Possession of a dorsal hollow nerve cord.
- Presence of pharyngeal slits at some stage of development.
- Presence of a post-anal tail in the embryonic stage.
- Endoskeleton made of bones.
- Bilateral symmetry and organ system organization.

ii. Class to which bean plant belongs.
The bean plant belongs to the class Magnoliopsida (Dicotyledonae) due to the following reasons:
- Presence of two cotyledons in seeds.
- Reticulate venation in leaves.
- Taproot system.
- Flowers with parts in multiples of four or five.
- Vascular bundles arranged in a ring in the stem.
- Presence of pollen grains with three furrows or pores.

2. (a) Study Figure 1 and answer questions which follow.

i. Name the organism.
The organism is a fern.

ii. Classify the organism to division level.
The organism belongs to the division Pteridophyta.

iii. Explain four general and three distinctive features of the kingdom to which the organism belongs.

General features:
- Eukaryotic: Cells have a defined nucleus and membrane-bound organelles.
- Multicellular: Composed of multiple cells organized into tissues.
- Autotrophic: Capable of photosynthesis using chlorophyll.
- Cell wall: Made of cellulose.

Distinctive features of Pteridophyta:
- Presence of vascular tissue (xylem and phloem) for transport of water and nutrients.
- Sporophyte is the dominant phase of the life cycle.
- Reproduction occurs through spores; no seeds are produced.

(b) i. Identify the parts labeled U, V, W, X, Y, and Z.
- U: Leaf (frond)
- V: Sporangium
- W: Stem
- X: Rhizome
- Y: Root
- Z: Rhizoids

ii. State three roles played by the part labeled Y.
- Absorption of water and minerals from the soil.
- Anchorage to the substrate.
- Storage of food materials.

iii. Give five ways in which the organism structurally adapts to its mode of life.
- Rhizome for underground growth and nutrient storage.
- Fronds for photosynthesis and spore production.
- Presence of vascular tissues for efficient transport of water and nutrients.
- Sporangia for spore production and dispersal.
- Roots and rhizoids for anchorage and absorption of nutrients.

3. (a) Describe the location, role, and effects of apical, lateral, and intercalary meristems. Tabulate your answers as shown in the table.

Type of Meristem	Location	Role	Effect
Apical Meristem	Found at the tips of roots and shoots	Responsible for primary growth in plants, increasing length	Increases plant height and root depth
Lateral Meristem	Found in the cambium of roots and stems	Responsible for secondary growth, increasing girth	Increases thickness of stems and roots
Intercalary Meristem	Found at internodes or base of leaves in grasses	Facilitates regrowth and elongation of leaves and internodes	Enables regeneration and rapid vertical growth

(b) Figure 2 shows relative changes in dry mass of endosperm and embryo during germination of barley. Explain the results shown by endosperm, embryo, and total mass curves.

- Endosperm:

The dry mass of the endosperm decreases over time as it is broken down to provide nutrients for the developing embryo. Enzymes such as amylase convert stored starch in the endosperm into glucose, which is utilized for energy and growth.

- Embryo:

The dry mass of the embryo increases over time as it absorbs nutrients from the endosperm and undergoes cell division and elongation. This increase indicates the development of new plant tissues.

- Total Mass:

The total mass initially decreases due to the consumption of stored nutrients. However, as the embryo grows and begins photosynthesis, the total mass stabilizes and starts increasing.

4. (a) (i) State two main roles played by the kidney.

- Excretion: The kidney removes metabolic waste products such as urea, creatinine, and uric acid from the blood.
- Osmoregulation: It regulates water and salt balance in the body to maintain homeostasis.

(ii) Complete the table summarizing the relationship between excretory product and habitat.

Animal	Excretory Product	Habitat
Protozoan	Ammonia	Aquatic
Terrestrial insect	Uric acid	Terrestrial
Freshwater bony fish	Ammonia	Freshwater
Marine bony fish	(TMAO)	Marine
Bird	Uric acid	Terrestrial
Mammal	Urea	Terrestrial and aquatic

(b) Enumerate three symptoms of each of the following disorders of the urinary system in humans:

(i) Bladder infection:

- Frequent and painful urination.
- Cloudy or strong-smelling urine.
- Lower abdominal pain or discomfort.

(ii) Kidney stone:

- Severe pain in the lower back or sides.
- Blood in urine.
- Difficulty or inability to urinate.

(iii) Kidney gout:

- Sudden intense joint pain, often in the big toe.
- Swelling and redness in the affected joints.
- Formation of urate crystals in the kidneys, leading to reduced kidney function.

(iv) Kidney failure:

- Swelling in the legs, ankles, or feet due to fluid retention.
- Decreased urine output or difficulty urinating.
- Fatigue and shortness of breath due to toxin buildup in the blood.

5. (a) State three features of DNA which enable it to:

(i) Serve as a store of genetic information.
i. Double-stranded structure: The complementary base pairing ensures stability, protecting genetic information from damage.
ii. Sequence of nitrogenous bases: The specific order of bases encodes genetic instructions.
iii. Long molecule: DNA's length allows it to store large amounts of genetic information efficiently.

(ii) Transmit genetic information accurately.
i. Complementary base pairing: Ensures exact copying during replication.
ii. Semi-conservative replication: Produces new molecules containing one original strand and one new strand, reducing replication errors.
iii. Stability: DNA's chemical structure minimizes mutations.

(b) (i) Using appropriate genetic symbols, carry out genetic crosses to show the percentage phenotype of blood group of children, whose parents are both heterozygous (father being blood group A and mother AB).

Symbols:
- IA = A allele
- IB = B allele
- i = O allele

Parental genotypes: Father (IAi) x Mother (IAIB)

Cross:

	IA (mother)	IB (mother)
IA (father)	IAIA	IAIB
i (father)	IAi	IBi

Phenotypic ratio:
i. Blood group A: 50%
ii. Blood group AB: 25%
iii. Blood group B: 25%

(ii) What is the probability that the parents will have a child with blood group O?
i. 0%.
Explanation: Blood group O requires two recessive alleles (ii), but neither parent has two recessive alleles.

6. (a) Explain how the formation of messenger ribonucleic acid takes place during protein synthesis.

Messenger RNA (mRNA) formation occurs in transcription:
i. Initiation: RNA polymerase binds to the promoter region of the DNA strand.
ii. Unwinding: The DNA double helix unwinds, exposing the template strand.
iii. Complementary base pairing: RNA polymerase adds RNA nucleotides complementary to the DNA template.
iv. Elongation: RNA polymerase synthesizes the mRNA strand.
v. Termination: Transcription stops when RNA polymerase reaches a terminator sequence.
vi. Processing: In eukaryotes, the mRNA undergoes splicing, capping, and poly-A tail addition.

(b) (i) Identify three types of ribonucleic acids.
i. Messenger RNA (mRNA)
ii. Transfer RNA (tRNA)
iii. Ribosomal RNA (rRNA)

(ii) Describe the structure and location of the types of ribonucleic acids identified in 6(b)(i).
i. mRNA: Single-stranded; found in the nucleus and cytoplasm.
ii. tRNA: Cloverleaf structure with an anticodon and amino acid attachment site; located in the cytoplasm.
iii. rRNA: Folded into complex structures forming ribosomes; located in ribosomes.

7. (a) (i) Name three theories of the origin of life.
i. Abiogenesis (spontaneous generation).
ii. Biogenesis.
iii. Chemical evolution.

(ii) Explain the origin of life based on the theories named in 7(a)(i).
i. Abiogenesis: Life arose spontaneously from non-living matter. Aristotle believed life could emerge from decaying organic matter.
ii. Biogenesis: Life originates only from pre-existing life, supported by Pasteur's experiments.
iii. Chemical evolution: Simple chemical compounds formed complex molecules, leading to life. Oparin and Haldane proposed this theory, supported by the Miller-Urey experiment.

(b) Explain the mechanism of organic evolution according to Lamarck's theory and state strengths and weaknesses of the theory.

Mechanism:
i. Use and disuse: Frequently used organs become stronger, while unused organs weaken.
ii. Inheritance of acquired traits: Acquired traits are passed to offspring.

Strengths:

i. Recognized the importance of environmental changes in evolution.
ii. Provided an explanation for organismal adaptations.

Weaknesses:
i. Lack of evidence for inheritance of acquired traits.
ii. Contradicted by genetic studies showing DNA determines traits.

8. (a) (i) Define the term population explosion and explain three causes of it.

Population explosion is the rapid and dramatic increase in the human population over a short period.

Causes:
i. Improved healthcare: Lower mortality rates due to medical advancements.
ii. Agricultural advancements: Increased food supply supports larger populations.
iii. Cultural factors: High fertility rates in some societies.

(ii) State five negative consequences of population explosion.
i. Resource depletion: Scarcity of water, food, and energy.
ii. Environmental degradation: Increased pollution and deforestation.
iii. Overcrowding: Poor living conditions in urban areas.
iv. Unemployment: Insufficient jobs for a growing population.
v. Pressure on healthcare and education systems.

(b) (i) What is capture-recapture method?

The capture-recapture method estimates population size by capturing, marking, releasing, and recapturing individuals.

(ii) Outline nine procedures used to estimate population under capture-recapture method.
i. Define the study area.
ii. Capture a random sample of individuals.
iii. Mark each captured individual uniquely.
iv. Release marked individuals back into the habitat.
v. Allow time for marked individuals to mix with the population.
vi. Recapture a second sample.
vii. Count marked and unmarked individuals in the second sample.
viii. Apply the formula: Population size = (Number of marked × Total recaptured) ÷ Marked recaptures.
ix. Repeat the process to ensure accuracy.