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: 1994.**

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. (a) What is meiosis?

Meiosis is a type of cell division that reduces the chromosome number by half, resulting in four haploid cells from one diploid cell. It occurs in two stages: meiosis I and meiosis II. This process is essential for sexual reproduction, as it produces gametes (sperm and egg cells) in animals and spores in plants.

(b) Outline the events occurring in the 1st meiotic prophase and 1st meiotic metaphase.
1st meiotic prophase
This phase is subdivided into five stages:

- Leptotene: Chromosomes condense and become visible as thin threads.
- Zygotene: Homologous chromosomes pair up (synapsis) to form bivalents.
- Pachytene: Crossing over occurs, where genetic material is exchanged between non-sister chromatids of homologous chromosomes.
- Diplotene: Homologous chromosomes begin to separate but remain connected at chiasmata.
- Diakinesis: Chromosomes condense further, and the nuclear membrane begins to disintegrate.

1st meiotic metaphase.
- The bivalents (paired homologous chromosomes) align at the equatorial plane of the cell.
- Spindle fibers attach to the centromeres of each homologous chromosome.

2. Discuss the locations and functions of:

(a) Meristematic tissue in the body of a flowering plant.
Location: Meristematic tissue is found at the tips of roots and shoots (apical meristem), in the vascular bundles (lateral meristem), and at the base of leaves or nodes (intercalary meristem).

Functions:
(i) Apical meristem is responsible for primary growth, increasing the length of roots and shoots.
(ii) Lateral meristem causes secondary growth, increasing the thickness of stems and roots.
(iii) Intercalary meristem contributes to the regrowth of leaves and stems.

(b) (i) Adipose tissue in the body of a mammal.

Location: Adipose tissue is found beneath the skin (subcutaneous fat), around internal organs (visceral fat), in bone marrow, and in breast tissue.

Functions:
(i) Stores energy in the form of lipids.
(ii) Provides insulation to maintain body temperature.
(iii) Protects internal organs by acting as a cushion.

(ii) Smooth muscle in the body of a mammal.

Location: Smooth muscles are found in the walls of internal organs such as the stomach, intestines, blood vessels, and the urinary bladder.

Functions:
(i) Involuntary contraction to propel substances through organs (e.g., peristalsis in the intestines).
(ii) Regulates blood flow by contracting and relaxing blood vessels.
(iii) Controls the movement of fluids in the urinary and reproductive systems.

3. In what ways are fungi important to man?

Fungi are significant to humans in various ways:

(i) Food production: Fungi like yeast are used in baking (bread-making) and fermentation (beer and wine production).
(ii) Medicine: Some fungi, such as Penicillium, produce antibiotics like penicillin, which are used to treat bacterial infections.
(iii) Nutrient recycling: Fungi act as decomposers, breaking down organic matter and recycling nutrients into the ecosystem.
(iv) Agriculture: Mycorrhizal fungi form symbiotic relationships with plant roots, enhancing nutrient absorption and plant growth.
(v) Food source: Edible fungi, such as mushrooms, are consumed as a source of protein and nutrients.
(vi) Industry: Fungi are used in the production of enzymes and organic acids for industrial purposes.
(vii) Biotechnology: Fungi are used in genetic research and the production of genetically modified organisms.

4. What are the distinguishing features of the different classes of arthropods?

Arthropods are classified into several classes based on their distinguishing features:

(i) Insects:
- Body divided into three segments: head, thorax, and abdomen.
- Three pairs of legs and one or two pairs of wings.
- Antennae present (e.g., grasshopper, butterfly).

(ii) Arachnids:
- Body divided into two segments: cephalothorax and abdomen.
- Four pairs of legs and no antennae or wings.
- Examples include spiders, scorpions, and ticks.

(iii) Crustaceans:
- Body divided into cephalothorax and abdomen.
- Five or more pairs of legs, two pairs of antennae.
- Mostly aquatic (e.g., crabs, lobsters).

(iv) Myriapods:
- Body elongated and divided into numerous segments.
- Each segment has one or two pairs of legs.
- Examples include centipedes (one pair of legs per segment) and millipedes (two pairs of legs per segment).

(v) Chilopoda (centipedes):
- Carnivorous with a flattened body and one pair of legs per segment.

(vi) Diplopoda (millipedes):
- Herbivorous with a cylindrical body and two pairs of legs per segment.

5. Explain the following defects of the human eye: myopia, hypermetropia, and astigmatism. What corrective measures can be taken for each defect?

(i) Myopia (short-sightedness):
Myopia occurs when the eyeball is too long or the lens is too curved, causing light rays to focus in front of the retina instead of on it. This results in difficulty seeing distant objects clearly.

Corrective measure: Concave lenses are used to diverge the light rays before they enter the eye, ensuring they focus on the retina.

(ii) Hypermetropia (long-sightedness):
Hypermetropia occurs when the eyeball is too short or the lens is not curved enough, causing light rays to focus behind the retina. This results in difficulty seeing nearby objects clearly.

Corrective measure: Convex lenses are used to converge light rays so they focus on the retina.

(iii) Astigmatism:
Astigmatism occurs due to an irregularly shaped cornea or lens, causing light rays to focus on multiple points on or near the retina. This results in blurred or distorted vision.

Corrective measure: Cylindrical lenses are used to correct the uneven curvature of the cornea or lens.

6. Give an account of hormones that influence growth and development in mammals.

(i) Growth hormone (GH): Secreted by the pituitary gland, it stimulates growth of bones, muscles, and tissues by promoting protein synthesis and cell division.
(ii) Thyroxine: Secreted by the thyroid gland, it regulates metabolic rate and supports the growth and development of tissues.
(iii) Insulin: Secreted by the pancreas, it regulates glucose metabolism, providing energy for growth processes.

(iv) Testosterone: In males, it stimulates the development of secondary sexual characteristics and promotes muscle and bone growth.
(v) Estrogen: In females, it regulates the development of secondary sexual characteristics and the reproductive system.
(vi) Cortisol: Secreted by the adrenal glands, it helps regulate metabolism and stress responses, indirectly supporting growth.

7. Describe the cyclic and non-cyclic photophosphorylation pathways of the light reactions of photosynthesis. What are the products of these reactions?

(i) Cyclic photophosphorylation:
- Occurs in photosystem I.
- Electrons are excited by light energy and pass through an electron transport chain before returning to photosystem I.
- ATP is produced by the movement of protons across the thylakoid membrane but no NADPH or oxygen is produced.

(ii) Non-cyclic photophosphorylation:
- Involves both photosystem I and photosystem II.
- Electrons are excited in photosystem II and pass through an electron transport chain to photosystem I.
- Water molecules are split (photolysis), producing oxygen, electrons, and protons.
- ATP and NADPH are produced.

Products:
- Cyclic: ATP
- Non-cyclic: ATP, NADPH, and oxygen

8. Discuss the various types of evidence from living organisms which support the theory of evolution.

(i) Fossil evidence: Fossils show the progression of life forms over time, providing a record of extinct species and transitional forms (e.g., Archaeopteryx).
(ii) Comparative anatomy: Homologous structures (e.g., the forelimbs of mammals) indicate common ancestry, while analogous structures show adaptation to similar environments.
(iii) Embryology: Similar embryonic stages in different species suggest common ancestry.
(iv) Molecular biology: Similarities in DNA, RNA, and proteins among organisms indicate evolutionary relationships.
(v) Biogeography: Geographic distribution of species supports evolution (e.g., Darwin's finches).
(vi) Observable evolution: Examples include antibiotic resistance in bacteria and pesticide resistance in insects.

9. (a) In man, the ability to roll the tongue into almost a complete cycle is determined by a dominant gene while its recessive allele fails to produce this ability. A man and his wife can both roll their tongues. They are surprised to find that their daughter cannot. Explain this by showing the genotypes of all three persons.

The ability to roll the tongue is controlled by a dominant allele (R), while the inability to roll the tongue is controlled by a recessive allele (r).

- The man's genotype: Rr (heterozygous, as he can roll his tongue but has a child who cannot).
- The wife's genotype: Rr (heterozygous for the same reason).
- The daughter's genotype: rr (homozygous recessive, as she cannot roll her tongue).

Cross between Rr (father) and Rr (mother):

	R (father)	r (Father)
R(Mother)	RR	Rr
r (mother)	Rr	rr

The genotypic ratio is:
- RR: 25% (can roll tongue)
- Rr: 50% (can roll tongue)
- rr: 25% (cannot roll tongue)

Thus, the daughter cannot roll her tongue because she inherited the recessive allele from both parents (rr).

(b) Discuss the role of isolating mechanisms in the formation of new species.

Isolating mechanisms prevent interbreeding between populations, allowing them to evolve independently and form new species.

(i) Prezygotic isolation:
- Temporal isolation: Species reproduce at different times.
- Behavioral isolation: Differences in mating behaviors prevent interbreeding.
- Mechanical isolation: Incompatibility of reproductive structures.

(ii) Postzygotic isolation:
- Hybrid inviability: Zygote fails to develop.
- Hybrid sterility: Offspring are sterile (e.g., mule).
- Hybrid breakdown: Subsequent generations are weak or infertile.

Isolating mechanisms reduce gene flow, promoting speciation through genetic divergence over time.