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: 1995.**

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) describe the structure and functions of the following cell organelles:

(i) Golgi apparatus
The Golgi apparatus consists of a series of flattened, membrane-bound sacs called cisternae. It has two faces: the cis face, which receives materials from the endoplasmic reticulum, and the trans face, which ships materials out.

Functions:
- Modifies, sorts, and packages proteins and lipids for secretion or use within the cell.
- Produces lysosomes.
- Helps in the synthesis of polysaccharides for cell walls (in plants).

(ii) Chloroplast
Chloroplasts are double-membrane organelles found in plant cells. Inside, they contain thylakoids stacked into grana and surrounded by the stroma. Chlorophyll, the pigment for photosynthesis, is located in the thylakoids.

Functions:
- Site of photosynthesis, where light energy is converted into chemical energy.
- Produces oxygen as a byproduct during the light-dependent reactions.
- Synthesizes glucose through the Calvin cycle.

(b) The table below shows relative amounts of DNA in a cell of organism X measured during mitosis and meiosis.

(i) Account for the differences in DNA content among the different phases.
- During early interphase, the DNA content is 2 because the cell is in its normal state, preparing for division.
- In metaphase of mitosis, DNA content is 4 as the chromosomes have duplicated to ensure equal distribution to daughter cells.
- During late telophase, DNA content returns to 2 as the cells complete division and restore the normal DNA amount.
- In meiosis I (zygotene), the DNA content is 4 due to homologous chromosome pairing and duplication. In meiosis II (late telophase), the DNA content is halved to 1 as gametes form.

(ii) What would be the probable amount of DNA content in late telophase I and prophase II of meiosis? Explain.
In late telophase I, the DNA content is 2 because homologous chromosomes are separated, but each chromosome still consists of two chromatids. In prophase II, the DNA content remains at 2, as no DNA replication occurs between meiosis I and II.

2. (a) Distinguish between exocrine and endocrine glands.

Exocrine glands secrete substances such as enzymes and mucus through ducts to external or internal surfaces (e.g., sweat glands).
Endocrine glands secrete hormones directly into the bloodstream, without ducts (e.g., adrenal glands).

(b) Discuss with examples the structure of the major types of the exocrine glands in mammals.

(i) Merocrine glands: Release secretions through exocytosis (e.g., sweat glands).
(ii) Apocrine glands: Release secretions along with part of the cell membrane (e.g., mammary glands).
(iii) Holocrine glands: Release secretions by rupturing the entire cell (e.g., sebaceous glands).

3. (a) What are the similarities and differences between bryophytes and pteridophytes?

Similarities:
(i) Both are non-flowering plants that reproduce through spores.
(ii) Both require water for the movement of male gametes during fertilization.

Differences:
(i) Bryophytes lack true vascular tissue, while pteridophytes have well-developed vascular tissue (xylem and phloem).
(ii) The dominant stage in bryophytes is the gametophyte, whereas in pteridophytes, the sporophyte is the dominant stage.

(b) What do you understand by the term "Alternation of Generations"? Discuss the significance of alternation of generations to the life histories of plants.

Alternation of generations refers to the life cycle of plants that alternates between a haploid gametophyte stage and a diploid sporophyte stage.

Significance:
(i) It ensures genetic diversity through sexual reproduction.
(ii) The gametophyte produces gametes for fertilization, while the sporophyte produces spores for dispersal, allowing plants to adapt to various environments.
(iii) It allows plants to exploit both sexual and asexual reproductive strategies.

4. Justify the position of Homo sapiens in the phylum Chordata and class Mammalia.

Homo sapiens belong to the phylum Chordata because they possess:
(i) A notochord during embryonic development.
(ii) A dorsal hollow nerve cord.
(iii) Pharyngeal slits or pouches during development.

Homo sapiens are placed in the class Mammalia due to the presence of:
(i) Mammary glands for feeding offspring.
(ii) Hair or fur on the body.
(iii) Three middle ear bones and a neocortex in the brain.

5. Discuss the process of water absorption by roots and the movement of water from the roots to the leaves.

Water absorption:
Roots absorb water from the soil through root hairs via osmosis. The absorbed water enters the cortex and moves to the xylem through the apoplastic or symplastic pathways.

Movement of water:
Water is transported from the roots to the leaves through the xylem via:
(i) Root pressure: Forces water upward due to osmotic pressure in the roots.
(ii) Capillary action: Adhesion and cohesion allow water to move through narrow xylem vessels.
(iii) Transpiration pull: Evaporation of water from leaf stomata creates a suction force that pulls water upward.

6. State the changes which take place in the organs named below and discuss their importance during the fight-or-flight responses:

(i) Heart: Increases heart rate to pump more oxygenated blood to muscles.
(ii) Liver: Releases glucose into the bloodstream for energy.
(iii) Lungs: Increases breathing rate for more oxygen intake.
(iv) Skin: Blood flow is redirected to vital organs, causing pale skin.
(v) Skeletal muscles: Receive more oxygen and glucose to enhance movement and strength.
(vi) Alimentary canal: Digestion slows down to conserve energy for immediate action.
(vii) Eyes: Pupils dilate to improve vision.

7. Discuss the roles of the following chemicals in organisms:

(i) Water: Acts as a solvent for biochemical reactions, regulates temperature, transports nutrients and waste, and provides structural support in plants through turgor pressure.

(ii) Carbohydrates: Provide energy through cellular respiration, serve as structural components (e.g., cellulose in plants), and act as storage molecules (e.g., starch, glycogen).

8. (a) How may a species be defined by:

(i) A geneticist: A species is defined as a group of organisms that share a common gene pool and can interbreed to produce fertile offspring.
(ii) An evolutionist: A species is defined as a group of organisms sharing a common evolutionary ancestry and distinct morphological or genetic traits.

(iii) An ecologist: A species is defined as a group of organisms occupying a specific ecological niche, interacting with their environment in a unique way.

(b) Discuss the relationship between biotic potential and environmental resistance.

Biotic potential refers to the maximum reproductive capacity of a population under ideal conditions, without limiting factors like disease or competition. Environmental resistance encompasses the factors that limit population growth, such as predation, resource scarcity, and climate conditions.

Relationship:
(i) Biotic potential drives population growth, but environmental resistance acts as a counterforce, stabilizing populations within the carrying capacity of the ecosystem.
(ii) When environmental resistance increases (e.g., due to habitat loss), populations decrease, preventing unchecked growth from biotic potential.
(iii) A balance between biotic potential and environmental resistance ensures ecosystem stability and prevents overexploitation of resources.

9. Maula is a form six student with blood type A. She recently had a baby with blood type O, whose father she insisted was a fellow student called Kasheshe. Kasheshe refuted outright. This paternity case was taken to court where the following facts were established:

(i) Kasheshe's mother was of blood type A.
(ii) Kasheshe's father was of blood type B.

Would the law accuse or excuse Kasheshe? Use symbolized diagrams to show how you reach your conclusion.

Given Information:

1. Maula’s blood type is A.
2. The baby’s blood type is O.
3. Kasheshe’s mother’s blood type is A, and his father’s blood type is B.
4. Blood type O requires both parents to contribute an O allele.

Step 1: Determine Maula’s Genotype

Since Maula’s blood type is A, her genotype could be:
- AA: Homozygous dominant (both alleles are A).
- AO: Heterozygous (one A and one O allele).

For the baby to have blood type O (OO), Maula must contribute an O allele. Therefore, Maula’s genotype must be AO.

Step 2: Determine Kasheshe's Possible Genotype

Kasheshe's mother has blood type A, and his father has blood type B. Their possible genotypes are:
- Mother (A): AA or AO
- Father (B): BB or BO

Using a genetic cross, we calculate the possible genotypes for Kasheshe:

From the cross:
- If the mother is AA and the father is BO, possible offspring are AB and AO.
- If the mother is AO and the father is BO, possible offspring are AB, AO, BO, and OO.

Kasheshe's possible genotypes are AB, AO, BO, or OO.

Step 3: Analyze Possible Crosses Between Maula and Kasheshe

Maula's genotype is AO, and Kasheshe's genotype could be AB, AO, BO, or OO.

1. If Kasheshe is AB
   Maula (AO) x Kasheshe (AB):

Offspring possibilities:
- AA
- AB
- AO
- BO

No OO genotype is possible, so Kasheshe cannot be the father if his genotype is AB.

2. If Kasheshe is AO
   Maula (AO) x Kasheshe (AO):

Offspring possibilities:
- AA
- AO
- AO
- OO

A 25% chance exists for the baby to have blood type OO. Kasheshe could be the father.

3. If Kasheshe is BO
   Maula (AO) x Kasheshe (BO):

Offspring possibilities:
- AB
- BO
- AO
- OO

A 25% chance exists for the baby to have blood type OO. Kasheshe could be the father.

4. If Kasheshe is OO
Maula (AO) x Kasheshe (OO):

Offspring possibilities:
- AO
- OO
- AO
- OO

A 50% chance exists for the baby to have blood type OO. Kasheshe could be the father.

Conclusion

- If Kasheshe's genotype is AB, he cannot be the father as there is no possibility of producing a child with blood type O.
- If Kasheshe's genotype is AO, BO, or OO, he could be the father as these genotypes allow for the possibility of a child with blood type O.