**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: 2003.**

**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.

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1. (a) What is the importance of biological keys?

Biological keys are important for identifying and classifying organisms based on their observable characteristics. They provide a systematic approach to distinguish between closely related species and help in studying biodiversity.

(b) Explain briefly the significance of scientific naming of organisms.

Scientific naming provides a universal language for identifying and classifying organisms, avoiding confusion caused by local names. It ensures consistency and helps in understanding the relationships and evolutionary history of organisms.

2. (a) Why is yeast classified as a fungus?

Yeast is classified as a fungus because it is a eukaryotic organism that lacks chlorophyll, reproduces by budding or spore formation, and has a cell wall made of chitin. It is also heterotrophic, obtaining nutrients through absorption.

(b) List the features, in each case, which place fungi in the plant and animal kingdoms.
Features placing fungi in the plant kingdom:
- Presence of a cell wall (made of chitin, not cellulose).
- Stationary lifestyle.

Features placing fungi in the animal kingdom:
- Heterotrophic nutrition (absorptive rather than photosynthetic).
- Storage of glycogen as a carbohydrate reserve.

3. (a) How is the epithelial lining of the ileum adapted for the function it performs?

The epithelial lining of the ileum is adapted for absorption by:
- Having villi and microvilli that increase surface area.
- Possessing thin walls for easy diffusion.
- Containing blood capillaries and lacteals for transporting nutrients.
- Producing mucus to aid smooth passage of food.

(b) Explain a single and large epithelial cell of the lining of the ileum showing the features that adapt it to its function.
The epithelial lining of the ileum is primarily composed of simple columnar epithelial cells, known as enterocytes, which are specialized for nutrient absorption. These cells exhibit several structural features that enhance their absorptive efficiency.


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Microvilli. The apical surface of each enterocyte is covered with numerous microvilli, forming a "brush border" that significantly increases the cell's surface area, thereby facilitating greater nutrient absorption.

Tight junctions. Adjacent enterocytes are connected by tight junctions, which prevent the leakage of digestive enzymes and pathogens between cells, maintaining the integrity of the intestinal barrier.

Mitochondria. Abundant mitochondria are present to supply the energy required for active transport mechanisms involved in nutrient uptake.

Basal nucleus. The nucleus is located basally, allowing ample space in the apical region for the presence of organelles involved in absorption and processing of nutrients.

Glycocalyx. A glycoprotein-rich layer covers the microvilli, housing enzymes essential for the final stages of digestion and protecting the microvilli from mechanical and chemical damage.

4. (a) In what two main ways is the tricarboxylic acid cycle (TAC) important in respiration?

- It generates energy-rich molecules like NADH and $FADH_2$, which fuel the electron transport chain for ATP synthesis.
- It provides intermediate compounds used in biosynthetic pathways (e.g., amino acids and lipids).

(b) Explain briefly the two significant relationships between Krebs cycle and electron transport system.

- NADH and $FADH_2$ produced in the Krebs cycle donate electrons to the electron transport chain, driving ATP synthesis.
- Carbon dioxide released during the Krebs cycle is a byproduct of aerobic respiration.

5. (a) Define homeostasis.

Homeostasis is the process by which an organism maintains a stable internal environment despite changes in external conditions.

(b) Describe briefly the homeostatic roles of:

(i) Digestive system
- Breaks down food into nutrients and absorbs them to maintain energy balance.
- Regulates water and electrolyte balance through absorption.

(ii) Respiratory system
- Maintains oxygen and carbon dioxide levels in the blood.
- Helps regulate blood pH through the removal of $CO_2$.


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(iii) The kidneys
- Excrete metabolic wastes like urea.
- Regulate water and salt balance and maintain blood pressure.

6. (a) State Mendel's laws of heredity.

- Law of Segregation. During gamete formation, alleles for each gene segregate so that each gamete carries only one allele.
- Law of Independent Assortment. Genes for different traits assort independently of one another during gamete formation, provided they are not linked.

7. What would the offspring phenotype be if both parents were heterozygous for body color?
Using the genetic symbols:
- Genotypes of parents: Bb × Bb (where B = dominant body color, b = recessive body color).

- Punnett square:

| | **B** | **b** |
|---|---|---|
| **B** | BB | Bb |
| **b** | Bb | bb |

Phenotypic ratio:
- 3 dominant (B): Individuals with body color.
- 1 recessive (bb): Individuals with the recessive body color.

Offspring phenotypes:
- 75% dominant body color.
- 25% recessive body color.

What would the offspring phenotype of a cross between homozygous grey male flies and heterozygous grey female flies be?

- Genotypes of parents: GG (homozygous grey) × Gg (heterozygous grey).
- Punnett square:

| | **G** | **g** |
|---|---|---|
| **G** | GG | Gg |
| **g** | Gg | gg |

Phenotypic ratio:
- 100% grey body color.
- No recessive body color observed.


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8. (a) State Darwin's theory of natural selection.

Darwin's theory of natural selection states that organisms with traits better suited to their environment are more likely to survive and reproduce. These advantageous traits are passed to the next generation, leading to evolutionary change over time.

(b) What do you understand by a food chain?

A food chain is a linear sequence of organisms where energy is transferred from one organism to another through feeding relationships. It begins with producers and ends with top consumers or decomposers.

Leptomonas species pyramid of numbers:
Constructed as follows:
- Grass (producers): Large base population.
- Herbivorous mammal: Fewer in number than grass.
- Fleas: Parasites of mammals, more abundant.
- Leptomonas sp.: Parasites of fleas, highest in number.

(c) How does deforestation increase atmospheric carbon dioxide levels?

Deforestation increases carbon dioxide levels by:
- Reducing the number of trees that absorb $CO_2$ during photosynthesis.
- Releasing stored carbon in trees when they are burned or decompose.
- Disrupting ecosystems that regulate the carbon cycle.

9(a) Name the structures represented by labels A, B, C, and D.

- A: Phospholipid bilayer
- B: Protein channel
- C: Glycoprotein
- D: Cholesterol

(b) Name the biochemical substance formed when E and F combine.
- Adenosine triphosphate (ATP)

(c) What role does structure F play in the functions of a membrane?
- Structure F (likely ATP) provides energy required for active transport and other metabolic processes occurring in the membrane.


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10. (a) What is a phytohormone?

- A phytohormone is a chemical substance produced in plants that regulates growth, development, and responses to environmental stimuli.

(b) In what ways are phytohormones important in plant growth and development?
- Phytohormones control processes such as cell elongation, division, differentiation, flowering, fruit development, seed dormancy, and response to environmental stresses.

11. Using the oxygen dissociation curve of a human adult and a fetal hemoglobin at rest and at 37°C, explain briefly how a mammalian fetus is adapted to oxygen uptake in its environment.

- Fetal hemoglobin has a higher affinity for oxygen compared to adult hemoglobin, allowing it to effectively extract oxygen from the maternal blood supply in the placenta.

12. (a) Explain why it is important to employ active transport in the absorption of foodstuffs like monosaccharides, dipeptides, and amino acids.

- Active transport ensures the absorption of nutrients against their concentration gradient, enabling efficient uptake even when their concentration in the gut lumen is lower than in the blood.

(b) State the respiratory surface features common to all vertebrates and explain briefly the importance of each feature.
- Thin membrane: Facilitates rapid gas exchange.
- Moist surface: Allows gases to dissolve and diffuse efficiently.
- Rich blood supply: Maintains a concentration gradient for oxygen and carbon dioxide.
- Large surface area: Increases the efficiency of gas exchange.

13. (a) Distinguish complete from incomplete metamorphosis.

- Complete metamorphosis involves four distinct stages: egg, larva, pupa, and adult. Incomplete metamorphosis involves three stages: egg, nymph, and adult.
(b) Explain the hormonal control of metamorphosis (molting) in insects.
- Metamorphosis in insects is regulated by two hormones: ecdysone, which stimulates molting and the transformation of the exoskeleton, and juvenile hormone, which determines the developmental stage by maintaining juvenile characteristics when present in high levels.

14. (a) Name the parts labeled A–F.
A: Germinal epithelium
B: Spermatogonia
C: Primary spermatocytes
D: Secondary spermatocytes
E: Spermatozoa


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F: Sertoli cells

(b) Which structure forms the part labeled B?
Spermatogonia are formed from undifferentiated germ cells located in the germinal epithelium.

(c) Which process is involved in the transformation of structure C to D?
The process involved is meiosis, where primary spermatocytes undergo the first meiotic division to form secondary spermatocytes.

(d) Explain the function of the structure labeled F.
Sertoli cells provide nutritional and structural support to developing sperm cells. They also secrete substances that regulate spermatogenesis and protect sperm from the immune response of the body.

(e) Define and point out the consequences of double fertilization.
Double fertilization is a unique process in flowering plants where one sperm fertilizes the egg to form a diploid zygote, and the other sperm fuses with two polar nuclei to form a triploid endosperm. The consequences include the formation of the embryo for the next generation and the endosperm, which provides nourishment to the developing embryo.


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