**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: 2022.**

**Instructions:**

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

1. (a) In five points, describe the structural similarities and differences between the bodies of birds and mammals.

Similarities:
- Both birds and mammals are vertebrates, meaning they have a backbone that supports their bodies.
- They are warm-blooded (endothermic), maintaining a constant body temperature regardless of environmental changes.
- Both have a four-chambered heart, ensuring efficient oxygenated and deoxygenated blood separation.
- Both possess lungs for respiration, though their respiratory structures are adapted differently.
- Both exhibit internal fertilization, with offspring developing from fertilized eggs or live birth.

Differences:
- Birds have feathers for flight and insulation, while mammals have fur or hair for protection and insulation.
- Birds lay eggs with hard shells, while most mammals give birth to live young, except monotremes like the platypus.
- Mammals have mammary glands that produce milk to nourish their young, while birds feed their chicks by regurgitating food.
- Birds have lightweight, hollow bones for flight, whereas mammals generally have denser, solid bones.
- Birds possess a beak without teeth, while mammals typically have a jaw with teeth for chewing and grinding.

(b) Explain how amphibians adapt to their environments.

- Amphibians have moist, permeable skin that allows gas exchange, helping them respire in water and on land.
- They lay eggs in water or moist environments to prevent desiccation, as their eggs lack a protective shell.
- Amphibians have limbs adapted for both swimming and walking, allowing movement in aquatic and terrestrial habitats.
- Their larvae (e.g., tadpoles) are aquatic and undergo metamorphosis to become terrestrial adults.
- Many amphibians can hibernate during cold seasons or aestivate during dry periods to survive extreme conditions.

2. Describe the process of osmoregulation by Anti-Diuretic Hormone (ADH) in the human body.

Anti-Diuretic Hormone (ADH), also known as vasopressin, plays a crucial role in regulating water balance in the body.
- ADH is secreted by the posterior pituitary gland in response to dehydration or increased blood osmolarity.
- It acts on the kidneys, specifically the collecting ducts, increasing their permeability to water by inserting aquaporin channels.
- This results in more water being reabsorbed into the bloodstream, reducing urine output and concentrating the urine.
- As a result, blood osmolarity decreases, restoring water balance.

- When the body is overhydrated, ADH secretion is inhibited, leading to increased urine output and diluted urine.

3. (a) Explain internal and external factors that affect seed germination.

Internal factors:
- Seed viability: Only viable seeds with living embryonic tissue can germinate.
- Hormonal balance: Hormones like gibberellins promote germination, while abscisic acid inhibits it.
- Food reserves: The presence of stored nutrients in the seed supports initial growth until the seedling can photosynthesize.

External factors:
- Water: Activates enzymes and facilitates nutrient transport for growth.
- Oxygen: Necessary for aerobic respiration to generate energy for cellular activities.
- Temperature: Optimal temperatures are required for enzyme activity and metabolic processes.

(b) With the aid of a diagram, describe five events which occur during the telophase stage of mitosis.

During telophase:
- Chromosomes decondense into chromatin, becoming less visible.
- The nuclear envelope re-forms around each set of chromosomes, creating two distinct nuclei.
- The nucleolus reappears within the nuclei, signifying resumption of ribosome production.
- Spindle fibers disassemble, as they are no longer required.
- Cytokinesis begins, dividing the cytoplasm and completing cell division.

4. A cross between pure yellow testa and green testa bean seeds produced yellow testa seeds in $F_1$. On selfing the $F_1$ plants, $F_2$ had the phenotypes shown in the following table:

| $F_2$ Phenotype | Number |
|---|---|
| Yellow testa | 836 |
| Red testa | 212 |
| Green testa | 72 |

The phenotypic ratio of $F_2$ is close to 12:3:1, which indicates that the inheritance follows the principle of dominance and epistasis (a type of gene interaction where one gene masks the effect of another).

Genotypes:
- Yellow testa is controlled by dominant allele Y.
- Green testa is controlled by recessive allele y.
- Red testa results from the interaction of another gene R with Y.

P Generation:
Pure yellow testa (YYRR) crossed with green testa (yyrr):

- Gametes from yellow testa: YR
- Gametes from green testa: yr

$F_1$ Generation:
All $F_1$ plants are heterozygous (YyRr), resulting in yellow testa because Y is dominant over y.

$F_2$ Generation:
When the $F_1$ plants (YyRr) are selfed, a dihybrid cross is performed:

| | YR | Yr | yR | yr |
|---|---|---|---|---|
| YR | YYRR | YYRr | YyRR | YyRr |
| Yr | YYRr | YYrr | YyRr | Yyrr |
| yR | YyRR | YyRr | yyRR | yyRr |
| yr | YyRr | Yyrr | yyRr | yyrr |

Phenotypes:
1. Yellow testa: Occurs when Y is present and masks y, regardless of the combination with R or r.
   - Genotypes: YYRR, YYRr, YyRR, YyRr, YYrr, Yyrr.
   - Total = 12/16 or 75%.

2. Red testa: Occurs only when R is present and Y is heterozygous (Yy) or recessive (yy).
   - Genotypes: yyRR, yyRr.
   - Total = 3/16 or 18.75%.

3. Green testa: Occurs only when both Y and R are recessive (yyrr).
   - Genotype: yyrr.
   - Total = 1/16 or 6.25%.

Results:
The phenotypic ratio is 12:3:1, matching the observed data (yellow: 836, red: 212, green: 72).

This demonstrates that the inheritance of yellow, red, and green testa follows a dihybrid cross with dominance and epistasis.

5. (a) Briefly describe four theories of the origin of life.

- Special creation theory: Suggests life was created by a supernatural power.
- Abiogenesis: Proposes life arose spontaneously from non-living matter but was later disproven by Pasteur's experiments.
- Biochemical evolution: Suggests life originated from simple organic molecules in Earth's early environment, as supported by the Miller-Urey experiment.

- Panspermia: Proposes life came to Earth from extraterrestrial sources like meteorites.

(b) Outline strengths and weaknesses of each of the theories described in 5(a).

Special creation: Strength - Aligns with religious beliefs. Weakness - Lacks scientific evidence.
Abiogenesis: Strength - Simple explanation for early life. Weakness - Disproved experimentally.
Biochemical evolution: Strength - Supported by experimental data. Weakness - Does not explain the origin of the first molecules.
Panspermia: Strength - Explains extraterrestrial input. Weakness - Does not explain how life originated elsewhere.

6. (a) Giving an example in each, describe the interdependence of the following groups of organisms in the ecosystem:

(i) Detritivores and decomposers: Detritivores like earthworms break down organic matter into smaller pieces, which decomposers like fungi further decompose into nutrients for plants.
(ii) Producers and consumers: Plants (producers) convert sunlight into energy, which is consumed by herbivores and later carnivores.
(iii) Food chain and food web: A food chain (e.g., grass → grasshopper → frog → snake) shows a linear energy flow, while a food web interconnects multiple food chains for ecosystem stability.

(b) In five points, explain how energy flows within an ecosystem.

- Energy enters the ecosystem through producers that capture sunlight via photosynthesis.
- Primary consumers feed on producers, transferring energy up the food chain.
- Secondary and tertiary consumers feed on herbivores and carnivores, transferring energy further.
- Decomposers recycle energy from dead organisms back into the ecosystem.
- At each trophic level, energy is lost as heat through metabolic processes, limiting energy transfer efficiency.