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: 2024.**

Instructions:

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

1. Identify four classes of the phylum to which a crab belongs and analyze four characteristics of each class.

Arthropoda is the largest phylum in the animal kingdom, encompassing a vast diversity of species characterized by their jointed appendages and exoskeletons. A crab belongs to this phylum. The primary classes within Arthropoda include:

Class Crustacea:
This class primarily comprises aquatic organisms, though some have adapted to terrestrial environments. Key characteristics include:
- Body segmentation: Typically divided into two main regions: the cephalothorax (a fused head and thorax) and the abdomen.
- Antennae: Possess two pairs of antennae, which serve sensory functions such as detecting chemical signals and touch.
- Exoskeleton: Composed of chitin and often fortified with calcium carbonate, providing both protection and structural support.
- Respiration: Utilize gills for gas exchange, facilitating respiration in aquatic habitats.
Examples include crabs, lobsters, shrimp, and barnacles.

Class Insecta:
Insects represent the most diverse group within Arthropoda, occupying nearly every ecological niche. Their defining features are:
- Body segmentation: Divided into three distinct regions: head, thorax, and abdomen.
- Appendages: Typically have three pairs of legs attached to the thorax and, in many species, one or two pairs of wings.
- Respiration: Employ a tracheal system, consisting of spiracles and branching tubes, to facilitate gas exchange directly with tissues.
- Sensory organs: Equipped with compound eyes and a pair of antennae for detecting environmental cues.
Examples encompass butterflies, beetles, ants, and flies.
Class Arachnida:
This class includes primarily terrestrial organisms known for their predatory behaviors. Key characteristics are:
- Body segmentation: Divided into two main parts: the cephalothorax and the abdomen.
- Appendages: Feature four pairs of legs and lack antennae.
- Respiration: Utilize book lungs or tracheae for gas exchange.
- Feeding structures: Possess chelicerae (often modified into fangs) and pedipalps near the mouth, aiding in feeding and sensory perception.
Examples include spiders, scorpions, ticks, and mites.

Class Myriapoda:
Comprising elongated, segmented bodies, this class is exclusively terrestrial. Notable features include:
- Body segmentation: Consists of numerous segments, each bearing one or two pairs of legs.
- Antennae: Possess a single pair of antennae on the head segment.
- Respiration: Rely on a tracheal system for gas exchange.

- Feeding habits: Centipedes are predominantly carnivorous, using venomous claws to capture prey, while millipedes are detritivores, feeding on decaying organic matter.
Examples are centipedes and millipedes.

2. Describe four factors which determine the form in which nitrogenous wastes are eliminated in animals.

The form in which animals excrete nitrogenous waste is influenced by several interrelated factors:

a) Water availability:
The accessibility of water in an animal's environment plays a crucial role in determining the type of nitrogenous waste produced.
- Ammonia (ammonotelism): Highly toxic and requires significant amounts of water for dilution and excretion. Consequently, it is commonly excreted by aquatic animals, such as fish and amphibian larvae, which have abundant water access.
- Urea (ureotelism): Less toxic than ammonia and requires less water for excretion. Terrestrial animals, including mammals and adult amphibians, convert ammonia to urea in the liver through the urea cycle, allowing for water conservation.
- Uric acid (uricotelism): The least toxic and excreted as a semi-solid paste, minimizing water loss. This adaptation is seen in birds, reptiles, and some terrestrial invertebrates inhabiting arid environments.

b) Habitat:
An animal's habitat significantly influences its excretory mechanisms.
- Aquatic environments: Animals in these habitats can afford to excrete ammonia directly into the surrounding water, where it is rapidly diluted.
- Terrestrial environments: Land-dwelling animals often face water scarcity and have evolved to excrete less toxic substances like urea or uric acid to conserve water.

c) Energy availability:
The synthesis of different nitrogenous wastes requires varying energy expenditures.
- Ammonia: Excreting ammonia is energetically inexpensive, as it involves minimal biochemical processing.
- Urea: The conversion of ammonia to urea via the urea cycle demands additional energy input.
- Uric acid: Synthesizing uric acid is the most energy-intensive process but offers the advantage of maximal water conservation.
d) Evolutionary adaptations:
Over time, animals have developed excretory strategies that best suit their ecological niches and physiological constraints.
- Dietary influences: Carnivorous animals consuming high-protein diets generate substantial nitrogenous waste and often excrete urea.
- Developmental stages: Some animals alter their excretory products depending on their life stages and habitats, such as amphibians transitioning from ammonia to urea excretion during metamorphosis.

3. A viable bean seed was placed in the soil. After seven days, the seed developed into a seedling.

(a) Explain physiological processes which led to the development of the seedling.

The development of the seedling is facilitated by the following physiological processes:

1. Imbibition: The seed absorbs water from the soil, causing it to swell and break the seed coat. This activates enzymes and initiates germination.
2. Enzyme activation: Enzymes like amylase convert stored starch into glucose, which provides energy for growth. Proteases and lipases also break down proteins and lipids into usable forms.
3. Respiration: The seed undergoes aerobic respiration to produce ATP, which fuels cellular activities essential for growth.
4. Cell division and elongation: Active cell division occurs in the meristematic tissues of the seed, leading to root and shoot elongation.
5. Mobilization of stored food: Nutrients in the cotyledons or endosperm are transported to growing regions of the seedling.

(b) Analyze four external conditions that enabled the development of the seedling.

- Water: Water is essential for imbibition, enzyme activation, and the transport of nutrients. It also maintains turgidity for cell expansion.
- Oxygen: Required for aerobic respiration, which generates ATP for the growing seedling. Oxygen is absorbed from the air spaces in the soil.
- Temperature: Optimal temperatures promote enzymatic activity and metabolic processes. Extremely low or high temperatures can inhibit germination.
- Light: Once the seedling emerges from the soil, light is crucial for photosynthesis, enabling the seedling to produce its own food.

4. (a) Account for six successes of Mendel's work in genetics.

- Choice of pea plants: Mendel selected pea plants for their short life cycle, ease of cultivation, and distinct inheritable traits.
- Use of purebred plants: Mendel ensured that his plants were true-breeding, allowing him to observe clear inheritance patterns.
- Controlled pollination: He manually pollinated plants to ensure specific crosses and prevent unintended fertilization.
- Observation of distinct traits: Mendel chose traits with clear dominant and recessive patterns, such as flower color and seed shape.
- Quantitative analysis: Mendel recorded large amounts of data and applied statistical methods to analyze inheritance patterns.
- Discovery of inheritance laws: Mendel formulated the principles of segregation and independent assortment, laying the foundation for modern genetics.

(b) The following table shows blood transfusion in relation to the Rhesus factor. Assess the compatibility of the blood by putting in each cell a tick (✓) if there is no agglutination or a cross (X) if agglutination will occur.

Recipient/Donor	A+	A-	B+	B-	AB+	AB-	O+	O-
A+	✓	✓	X	X	✓	X	✓	✓
A-	X	✓	X	X	X	✓	X	✓
B+	X	X	✓	✓	✓	X	✓	✓
B-	X	X	X	✓	X	✓	X	✓

Compatibility is based on matching ABO groups and the presence (+) or absence (-) of the Rhesus factor.

5. Describe any four theories of the origin of life.

- Special creation theory: Suggests life was created by a divine or supernatural power. This theory is based on religious beliefs and does not rely on scientific evidence.
- Abiogenesis (spontaneous generation): Proposes that life arose spontaneously from non-living matter. This theory was widely accepted in ancient times but was later disproven by experiments like those of Louis Pasteur.
- Biochemical evolution: Suggests that life originated from simple organic molecules formed in Earth's early atmosphere. These molecules underwent chemical reactions, eventually leading to the formation of complex macromolecules and living organisms. Experiments like the Miller-Urey experiment support this theory.
- Panspermia: Proposes that life originated elsewhere in the universe and was brought to Earth by meteorites or comets containing microorganisms or organic compounds.

6. Describe the following types of the world biomes based on their characteristics and distribution.

(a) Chaparral:
- Found in Mediterranean regions, California, and parts of Australia.
- Characterized by hot, dry summers and mild, wet winters.
- Vegetation includes drought-resistant shrubs, small trees, and grasses.

(b) Tropical savannah:
- Found in Africa, South America, and Australia.
- Characterized by warm temperatures year-round with distinct wet and dry seasons.
- Vegetation includes grasses with scattered trees like acacias.

(c) Grassland:
- Found in North America (prairies), South America (pampas), and Eurasia (steppes).
- Characterized by moderate rainfall and dominated by grasses with few trees.

- Supports herbivorous animals like bison and antelope.

(d) Desert:
- Found in regions like the Sahara, Atacama, and Arabian deserts.
- Characterized by very low rainfall, extreme temperature fluctuations, and sparse vegetation.
- Vegetation includes cacti and drought-resistant plants, and animals are adapted for water conservation.