Student's Name:.....

Signature.....

Random No.						Personal No.		

BIOLOGY
PAPER 1
(Theory)
2 Hours 30 minutes

END OF CYCLE EXAMINATIONS TERM I 2026

BIOLOGY

Paper 1

(Theory)

2 HOURS 30 Minutes

INSTRUCTTIONS TO CANDIDATES:

This paper consists of **two** *sections:* **A** *and* **B.** *It has* **four** *examination items.*

Section **A** *has* **Two Compulsory** *items.*

Section **B** *has* **two** *ITEMS: Answer* **one ITEM**.

Answers to section **A must** *be written in the spaces provided while answers to* **Section B** *must be written in the answer booklet(s) provided.*

Answer **THREE** *items in all.*

Any additional item(s) answered will **not** *be scored*

SECTION A

Attempt all items in this section

ITEM 1

In a rural health center in Busia, several patients presented with skin infections characterized by redness, swelling, and tissue damage. Laboratory analysis revealed infection by bacteria that release toxins affecting epithelial cells.

Microscopic examination showed that the bacteria lacked a nucleus but had rigid cell walls, while the affected tissues had disrupted epithelial layers.

Further studies indicated that damaged epithelial tissues allowed easier entry of pathogens into deeper tissues.

Table: Observations in Skin Infection

Parameter	Healthy tissue	Infected tissue
Epithelial layer	Intact	Broken
Bacterial presence	None	High
Toxin production	None	High
Cell damage	None	Extensive

Reference: *"Bacterial Toxins and Epithelial Tissue Destruction" Infectious Disease Journal*

Task

(a) Explain how bacterial toxins and cell structure contribute to the destruction of epithelial tissues and progression of infection.

(b) Suggest measures that can promote healing and prevent further spread of infection.

(a) Explanation of observed changes

Bacteria lack a nucleus (prokaryotic) and have a rigid cell wall that protects them from physical damage and environmental stress, allowing them to survive and multiply on the skin and within tissues.

These bacteria produce toxins (enzymes and harmful substances) that break down cellular components such as proteins and lipids in epithelial cells. This leads to destruction of cell membranes and organelles, causing cell death.

High toxin production increases the rate of tissue damage. The toxins disrupt the epithelial layer, which normally acts as a protective barrier against pathogens.

Once the epithelial layer is broken, its barrier function is lost. This allows bacteria and their toxins to penetrate deeper into tissues, leading to further infection and inflammation.

The presence of many bacteria (high population) increases toxin levels, accelerating tissue destruction and worsening the infection.

(b) Strategies to promote healing and prevent spread

- *Clean wounds properly to remove bacteria and toxins from the infected area, reducing microbial load and preventing further tissue damage.*
- *Use appropriate antibiotics to kill or inhibit bacterial growth, reducing toxin production and allowing damaged tissues to recover.*
- *Maintain good personal hygiene to prevent transfer of bacteria to wounds or other individuals, limiting spread of infection.*
- *Cover wounds with clean dressings to protect epithelial tissues from further contamination and support healing by maintaining a clean environment.*
- *Seek early treatment to control infection before extensive tissue damage occurs, improving recovery and preventing complications.*

- *Promote health education in the community to improve awareness of wound care and hygiene practices, reducing incidence and spread of infections.*

ITEM 2

In Hoima District, farmers irrigating vegetables using water from a nearby hot spring noticed unusual plant responses. Some plants showed rapid initial growth, followed by wilting, reduced leaf expansion, and poor transport of nutrients.

Laboratory analysis of the water revealed the presence of microorganisms adapted to high temperatures, identified as archaea, along with some eubacteria. Further studies showed that plant cells exposed to this water had disrupted cytoplasm, reduced enzyme activity, and poor vacuole function.

Microscopic examination indicated that xylem and phloem tissues were poorly functioning, affecting transport processes.

Table: Observations in Irrigated Plants

Condition	Enzyme activity (% normal)	Vacuole function	Tissue transport efficiency	Growth
Clean water	100	Normal	Efficient	Healthy
Hot spring water	60	Reduced	Poor	Stunted
Mixed water	80	Moderate	Moderate	Fair

Reference: *"Effects of Extremophile Microorganisms on Plant Cellular Function" Environmental Microbiology Reports*

Task

(a) Explain how disruption of cytoplasm, enzyme activity, and vacuole function affects plant cell processes and transport in tissues.

(b) Suggest appropriate ways to manage irrigation and improve plant growth under such conditions.

(a) Explanation of observed changes

Disruption of the cytoplasm interferes with metabolic activities because many biochemical reactions occur in the cytosol. Enzymes and substrates are no longer properly distributed, reducing the efficiency of processes such as photosynthesis and respiration.

Reduced enzyme activity lowers the rate of metabolic reactions. Enzymes control pathways involved in energy production and synthesis of essential compounds; when activity drops (to 60%), less ATP and organic substances are produced, leading to slow growth.

Poor vacuole function affects storage and maintenance of cell turgor. The vacuole normally stores water and solutes; when its function is reduced, cells lose turgidity, resulting in wilting and reduced leaf expansion.

Impaired vacuole function also affects ion balance and detoxification, allowing harmful substances from microorganisms to accumulate in cells, further disrupting metabolism.

Poor functioning of xylem and phloem tissues reduces transport of water, minerals, and sugars. Xylem transport of water is reduced, while phloem translocation of food is limited, leading to inadequate supply of nutrients to growing parts.

Overall, disrupted cytoplasm, reduced enzyme activity, and poor vacuole function lead to impaired metabolism, loss of turgor, reduced transport efficiency, and stunted plant growth.

(b) Strategies to improve irrigation and plant growth

- *Avoid direct use of hot spring water to prevent exposure of plant cells to extreme temperatures and harmful microorganisms, protecting cytoplasmic processes and enzyme activity.*

- *Mix hot spring water with clean water to dilute temperature and microbial concentration, reducing their damaging effects on cells and improving plant growth conditions.*
- *Treat irrigation water before use to remove harmful microorganisms such as archaea and eubacteria, preventing disruption of cell functions and tissue transport systems.*
- *Monitor and regulate water temperature to maintain optimal conditions for enzyme activity, ensuring efficient metabolic processes in plant cells.*
- *Improve soil conditions using organic matter to enhance nutrient availability and support tissue function, helping plants recover from stress and maintain proper growth.*
- *Use resistant plant varieties that can tolerate high temperature and microbial stress, allowing better survival and productivity under challenging conditions*

SECTION B

Attempt one item from this section

ITEM 3

In Mukono District, a tree nursery reported that seedlings were growing slowly and showed poor leaf development and weak stems. Despite adequate watering, plants had reduced photosynthetic efficiency. Laboratory analysis revealed contamination of the soil with eubacteria that compete for nutrients and release substances affecting plant metabolism. Plant cells showed reduced chloroplast efficiency, low enzyme activity, and impaired cytoplasmic streaming.
Microscopic examination showed that parenchyma tissues were poorly developed, limiting storage and metabolic activities.
Table: Cellular and Tissue Observations in Seedlings

Parameter	Healthy seedlings	Affected seedlings
Enzyme activity	High	Low
Cytoplasmic movement	Active	Reduced
Chloroplast efficiency	High	Low
Parenchyma development	Normal	Poor

Reference: *"Soil Microbial Interactions and Plant Cell Function" Journal of Plant-Microbe Interactions*

Task

(a) Explain how eubacterial activity in soil affects plant cell metabolism, cytoplasmic processes, and tissue development.

(b) Suggest practical measures that can improve seedling growth and restore normal cellular and tissue functions.

(a) Explanation of observed changes

Eubacteria in the soil compete with plants for essential nutrients such as nitrates and phosphates. This reduces nutrient availability to plant roots, limiting synthesis of enzymes and other cellular components required for metabolism.

Some eubacteria release toxic substances (metabolites) that interfere with plant cell functions. These substances inhibit enzymes, lowering enzyme activity and slowing down metabolic processes such as photosynthesis and respiration.

Reduced enzyme activity lowers the rate of biochemical reactions, leading to decreased production of ATP and organic compounds. This results in poor growth and reduced development of plant structures.

Impaired cytoplasmic streaming slows the movement of organelles and distribution of materials within the cell. This reduces efficiency of processes such as transport of metabolites and positioning of chloroplasts, affecting photosynthesis.

Reduced chloroplast efficiency lowers the plant's ability to absorb light and carry out photosynthesis. This leads to less glucose production, limiting energy supply and growth.

Poor development of parenchyma tissues reduces storage and metabolic functions. Since parenchyma cells are involved in storage of food and photosynthesis, their underdevelopment leads to weak stems and poor leaf formation.

(b) Strategies to improve seedling growth

- ***Treat the soil through sterilization or solarization*** *to reduce harmful eubacterial populations, minimizing competition and toxin production, thereby restoring normal cellular metabolism.*
- ***Add organic manure*** *to improve soil fertility and promote beneficial microorganisms, which outcompete harmful bacteria and support nutrient availability for plant cells.*
- ***Practice crop rotation*** *to break the cycle of bacterial build-up in the soil, reducing harmful microbial populations and improving soil health.*
- ***Apply appropriate fertilizers*** *to replenish essential nutrients, supporting enzyme synthesis, chloroplast function, and overall plant growth.*
- ***Maintain proper watering*** *to support cytoplasmic streaming and metabolic activities, ensuring efficient transport of substances within plant cells.*
- ***Use certified healthy seedlings*** *to ensure plants start with strong cellular structures and resistance, improving their ability to grow under soil stress conditions.*

ITEM 4

In Mbale District, farmers growing cabbages observed that some plants developed internal tissue breakdown, water-soaked patches, and foul smell. The affected plants eventually collapsed.
Laboratory tests identified infection by eubacteria producing enzymes that break down cellular contents. Some microorganisms isolated from nearby soils were identified as archaea capable of surviving in low-oxygen conditions.
Cellular studies showed that plant cells had damaged organelles, reduced metabolic activity, and loss of internal organisation. Tissue analysis revealed that collenchyma and vascular tissues were weakened, leading to loss of support and transport.
Table: Observations in Healthy and Infected Plants

Parameter	Healthy plants	Infected plants
Enzyme activity	Normal	Disrupted
Organelle function	Active	Damaged
Tissue strength	Strong	Weak
Transport efficiency	Efficient	Poor

Reference: *"Bacterial Soft Rot and Tissue Degradation in Crops" Agricultural Pathology Journal*

Task

(a) Explain how bacterial enzyme activity and cellular damage lead to breakdown of plant tissues and loss of function.

(b) From the situation described outline ways to control the spread of infection and maintain healthy plant tissues.

(a) Explanation of observed changes

Eubacteria produce extracellular enzymes (e.g., cellulases, pectinases, proteases) that break down cell components. These enzymes digest middle lamella and cell contents, causing cells to lose cohesion and integrity, leading to soft, water-soaked tissues.
Breakdown of organelles disrupts essential cellular functions such as respiration and biosynthesis. Damaged mitochondria reduce ATP production, lowering energy available for maintenance and repair.

Disrupted enzyme activity interferes with metabolic pathways, reducing synthesis of structural and functional molecules. This leads to loss of internal organisation and further cellular breakdown.
Loss of cell integrity causes leakage of cellular contents, creating the foul smell associated with decomposition.
Weakening of collenchyma reduces mechanical support, causing plants to lose rigidity and collapse.
Damage to vascular tissues (xylem and phloem) impairs transport of water, minerals, and sugars. This leads to reduced distribution of nutrients and further decline in plant function.
Archaea surviving in low-oxygen (waterlogged) conditions contribute to persistence of infection by maintaining microbial activity even where oxygen is limited.

(b) Strategies to control infection and maintain healthy tissues

- *Remove and destroy infected plants to eliminate sources of bacteria and prevent spread of infection to healthy plants.*
- *Maintain good field hygiene by clearing plant debris and tools, reducing bacterial contamination and limiting infection sources.*
- *Avoid waterlogging in fields to reduce low-oxygen conditions that favor growth of bacteria and archaea, thereby limiting infection spread.*
- *Use resistant crop varieties to reduce susceptibility to bacterial infection, improving plant survival and reducing disease impact.*
- *Practice proper plant spacing to improve air circulation, reducing moisture accumulation and unfavorable conditions for bacterial growth.*
- *Apply appropriate treatments (e.g., recommended agrochemicals or biological control) to reduce bacterial population and enzyme activity, helping to control infection and protect plant tissues.*

END