Student's Name:.....

Signature.....

Random No.						Personal No.		

BIOLOGY
PAPER 1
(Theory)
SET TWO
2 Hours 30 minutes

BIOCLASS HUB

Uganda Advanced Certificate of Education
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(Compulsory)

ITEM 1

Cystic Fibrosis is a genetic disease caused by a faulty ion channel protein, leading to thick mucus that blocks ducts and tubes lined with epithelium. In the pancreas, this blocks the release of digestive enzymes. A researcher is studying how the resulting nutrient malabsorption affects cellular respiration in intestinal epithelial cells.

Table: Analysis of Intestinal Epithelial Cells in a CF Model

Cell Parameter	Cystic Fibrosis Model	Healthy Model
Thickness of mucus layer	150 µm	50 µm
Glucose absorption efficiency	30%	95%
Pyruvate Dehydrogenase Activity	Low	Normal
Mitochondrial ATP Output	Low	Normal

Task:

(a) Analyse the sequence of events, from the faulty protein to the thick mucus, and finally to the reduced ATP output in the intestinal epithelial cells, explaining the role of glucose and pyruvate dehydrogenase.

(b) Justify a nutritional supplement strategy that could bypass the blocked digestive enzymes and provide substrates to support the aerobic respiration of the gut epithelium.

ITEM 2

In Karamoja, farmers are testing sorghum and amaranthus for drought resistance.
During prolonged dry spells, sorghum stays green and continues growing, while amaranthus wilts rapidly and shows reduced leaf area.
Scientists recorded data on leaf anatomy, chloroplast density, stomatal behaviour, and water content of both plants under the same conditions.
Data

Plant	Leaf Type	Average Leaf Water Content (%)	Chloroplasts per Mesophyll Cell	Average Stomatal Opening (μm)	Photosynthetic Pathway
Sorghum	Narrow with thick cuticle	80	60	2.0	C_4
Amaranthus	Broad with thin cuticle	55	38	4.5	C_3

Reference: *"Drought Adaptations and Photosynthetic Pathway Efficiency in Tropical Crops, Journal of Plant Ecology (2022)."*

Task:

Using the information provided,

(a) Explain the physiological reasons why sorghum survives better than amaranthus under drought.

(b) Propose strategies to enhance drought resistance of amaranthus in Karamoja.

SECTION B

Attempt one item from this section

ITEM 3

During a heatwave, a marathon runner, David, stops sweating and becomes confused and agitated. His core body temperature is 40.5°C. He is diagnosed with heatstroke. Meanwhile, his teammate, Lisa, who drank a balanced electrolyte solution throughout the race, finished strongly with a core temperature of 38.5°C. David's urine is very concentrated and dark yellow.

Table: Thermoregulatory and Osmoregulatory Responses

Parameter	David (Heatstroke)	Lisa (Normal)
Core Temperature (°C)	40.5	38.5
Sweat Rate (L/h)	0 (ceased)	1.2
Plasma Osmolarity (mOsm/L)	High	Normal
Likely ADH Level	Very High	Moderately High
Skin Blood Flow	Reduced	Increased

Task:

(a) Explain the homeostatic failure in David's case. Describe how the hypothalamus normally regulates temperature and how osmoregulation is linked to this process during dehydration.
(b) Justify the emergency treatment for David and a behavioural strategy to prevent recurrence.

ITEM 4

A previously healthy young man develops a severe bacterial infection. His innate immune system initially controls it, but the infection persists. Blood tests show normal white blood cell counts but a specific deficiency in the production of antibodies. This leaves him vulnerable to recurrent infections that most people fight off easily.

Table: Immune Response Analysis

Component	Patient Status	Normal Function
Phagocytosis by Neutrophils	Normal	Engulfs and destroys bacteria (Innate)
T-cell Count	Normal	Cell-mediated immunity (Adaptive)
B-cell Count	Normal	Produces antibodies (Adaptive)
Antibody Levels (IgG, IgA)	Very Low	Neutralizes pathogens and tags them for destruction

Tasks:

(a) Distinguish between the roles of the innate and adaptive immune systems in this case, explaining why the patient can initially control the infection but suffers from recurrences.
(b) Propose strategies that could help protect him from future infections and explain its mechanism.

TAP THE LINK BELOW FOR THE SCORING/MARKING GUIDE

https://www.youtube.com/watch?v=YHb2lB41ifU

END