Student's Name:.....

Signature.....

Random No.						Personal No.		

BIOLOGY
PAPER 1
(Theory)
SET THREE
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

Attempt all questions

ITEM ONE

A food poisoning outbreak is traced to a bacterial toxin that destroys the tight junctions between intestinal epithelial cells. This allows the toxin to enter the bloodstream. The toxin's mechanism is to act as a non-competitive inhibitor of succinate dehydrogenase, a crucial enzyme in both the Krebs cycle and the electron transport chain.

Table: Systemic Effects of the Bacterial Toxin

Tissue/Analyte	Observed Effect	Underlying Cause
Intestinal Epithelium	Loss of barrier function; inflammation	Destruction of tight junctions
Blood Serum	High levels of succinate	Inhibition of succinate dehydrogenase
Muscle Cells	Low ATP, cramping	Disrupted Krebs cycle and electron transport
Kidney Tubules	Reduced filtration rate	Epithelial cells lining tubules are energy-deficient

TASK:

(a) Explain the dual consequence of this toxin: first, how it breaches the body's primary epithelial barrier, and second, how its enzymatic inhibition disrupts aerobic respiration systemically.

(b) Propose strategies to manage this poisoning, addressing both the epithelial damage and the metabolic crisis.

ITEM TWO

Farmers in Mbale (Mt. Elgon slopes) and Gulu (Northern Uganda) reported contrasting yields of beans and sorghum. Beans thrive in Mbale but fail in Gulu, while sorghum thrives in Gulu but shows yellowing and stunted growth in Mbale.

A student investigation compared environmental factors, leaf anatomy, and photosynthetic activity of these crops in the two districts.

District	Altitude (m)	Average Temperature (°C)	Rainfall (mm/year)	Dominant Vegetation	Type of Leaf Anatomy	Rate of CO_2 Uptake ($\mu mol\ m^{-2}s^{-1}$)	Main Excretory Product
Mbale	1600	20	1500	Bananas, beans	C3 (no Kranz)	18	Latex
Gulu	900	33	700	Acacia, sorghum	C4 (Kranz present)	32	Oils

Farmers from Gulu recently attempted growing beans using irrigation but yields remained low despite frequent watering.

Adapted: *"Comparative Analysis of C3 and C4 Crop Adaptations in East Africa." African Plant Science Review, 2022.*

TASK:

(a) Assess why beans and sorghum show contrasting performance in Mbale and Gulu.

(b) Suggest strategies that could help improve the yield of beans in Gulu based on the physiological and anatomical characteristics of the plants.

SECTION B

Attempt one item from this section

ITEM THREE

During the National Cross-Country Marathon held in Kapchorwa (2,200 m above sea level), four athletes Joel, Brian, Lydia, and Mary competed in a 15 km race. Before the event, the weather was cold and dry.

After the race, medical officers recorded the following data:

Athlete	Heart rate after race (beats/min)	**Blood O_2** saturation (%)	Sweat volume (mL/min)	Core body temp (°C)	White blood cell count **($\times 10^9$/L)**
Joel	110	90	2.5	37.5	8.0
Brian	155	82	5.5	39.8	10.5
Lydia	135	86	1.8	38.2	7.0
Mary	120	89	2.0	37.6	8.5

Only Brian reported dizziness and muscle cramps after the race.

Adapted:*"Effects of Altitude on Cardiovascular and Thermoregulatory Responses in Athletes." African Journal of Human Biology, 2023.*

TASK:

(a) Using the data, explain the physiological reasons for the observed differences in body temperature, heart rate, and oxygen saturation.

(b) Suggest strategies that could help Brian recover and maintain homeostasis after intense exercise at high altitude.

ITEM FOUR

During the *National Mountain Marathon* held in Kapchorwa (altitude 2,200 m), three athletes Peter, Sarah, and James showed different endurance abilities.

All trained for three months under distinct environmental conditions before the event:

- Peter trained at sea level (Entebbe).
- Sarah trained in Kapchorwa.
- James trained in Mbarara (1,400 m) but recently recovered from mild carbon monoxide exposure after sleeping near a charcoal stove.

Before and after the race, physiological data were recorded:

Parameter	Peter	Sarah	James
Resting heart rate (beats/min)	68	60	72
Heart rate after race	160	120	185
Blood O_2 saturation (%)	98	93	82
Blood CO_2 concentration (%)	3.5	4.2	5.8
Haemoglobin level (g/dL)	14.5	17.2	13.0
Recovery time to normal breathing (min)	10	3	18

Sarah completed the race first, followed by Peter, while James collapsed and required oxygen therapy.

Task:

(a) Explain the physiological reasons for the different performances among the three athletes.

(b) Suggest strategies that could help James improve his performance and recovery.

TAP THE LINK BELOW FOR THE SCORING GUIDE

https://www.youtube.com/watch?v=OCCXhYZX7eU&t=3s

END