Candidate's Name:.....

Signature..... Random No. Personal No.

BOARD OF REGIONAL MOCKS ASSOCIATION

Uganda Advanced Certificate of Education

BIOLOGY

530/1

THEORY

3HOURS

INSTRUCTIONS TO CANDIDATES

This paper consists of two sections. Section A and B. It has six examination items.

Section A has two compulsory items. Section B has two parts: Part I and part II

Respond one item from each part in section B. Answer four items in all.

Item 1

1. In Lwabiyata Sub County , Friesian cows are producing 30% less milk during the dry season. The animals graze in open fields with no shade and limited water access. Farmers report fast shallow breathing, dry tongues, and frequent lying down during midday. Blood tests show reduced hemoglobin and mitochondrial enzyme activity. In contrast, cows grazing near a shaded valley with water troughs maintain normal productivity.

Parameter	**Affected Herd (Open Field)**	**Healthy Herd (Shaded Valley)**
Body temperature (°C)	40.2	35
Breathing rate (breaths/min)	90	60
Blood hemoglobin (g/dL)	5	13.5
ATP synthase activity (% of normal)	60	100
Milk yield (L/day)	4	20

Task

a) Analyse how the data show effects of heat on oxygen uptake, mitochondrial activity, and milk production.

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b) Propose strategies to restore herd productivity

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Item 2

In an agricultural biotechnology project, students tested how temperature affects enzyme activity in the photosynthetic process. They compared PEP carboxylase (C4 enzyme) and Rubisco (C3 enzyme) at different temperatures. At 35°C, sorghum plants maintained high photosynthetic rates, while oat plants showed reduced growth and curled leaves

Temperature (°C)	**PEP Carboxylase activity (relative units)**	**Rubisco activity (relative units)**
20	60	80
25	75	95
30	85	87
35	90	75
40	79	35

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Task:

a) Analyse the data to explain why C4 plants outperform C3 plants at high temperatures

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b) Propose strategies farmers could apply to sustain food security amid rising global temperatures

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SECTION B

SUB SECTION 1

Item 3

1. During a Biology field trip in Kweeni, students camped in semi-desert grasslands. Temperatures reached 41°C at noon and dropped to 10°C at night. One group forgot their shade tent and drinking water. By the second day, some students showed ; increased breathing and dry lip, Dizziness and low urine output, Hot skin but reduced sweating. Other students, who had been drinking energy drinks with caffeine, remained alert but later developed muscle cramps.

The school nurse measured the following:

Students	**Body Temp (°C)**	**Urine Volume (mL/hr)**	**Pulse (beats/min)**	**Plasma ADH Level (pg/mL)**
Group A (no shade,	39.8	8	120	20
Group B (same	39.2	10	118	22
Group C (with	37.5	40	85	6
Group D (in shade,	36.8	60	75	5

Task:

a) Analyse how the physiological responses observed in the students demonstrate temperature regulation and water balance mechanisms in humans.

b) Suggest scientifically sound strategies to prevent dehydration and overheating during future field trips, using evidence from the scenario.

Item 4

Electrophysiological recordings from a neuronal membrane in a rat was measured the **Action Potential (AP)** amplitude under varying external ionic concentrations were recorded as in the table below.

External [K^+] (mmol/L)	RMP (mV)	AP Amplitude (mV)
5 (Normal)	-70	+110
50 (Elevated)	-30	+40

Task:

a) Analyze why elevating external potassium levels leads to the depolarization of the resting membrane potential.

b) Evaluate the impact of **Tetrodotoxin (TTX)** on the propagation of the nerve impulse.

c) Local anesthetics like Lidocaine work by blocking voltage-gated Na^+ channels. Design a **pharmacological strategy** to manage chronic pain that targets signal conduction without affecting the autonomic nervous system.

SUB SECTION II

Item 5

Farmers near a freshwater lake in Uganda frequently spray chemical pesticides such as DDT to control insect pests on their crops. However, ecologists have observed that the use of these chemicals sometimes disrupts the natural balance of the ecosystem. A study was conducted to measure how the pesticide accumulates in organisms found in the lake. The results are shown below:

Site of DDT measurement	Amount of DDT in parts per million
Water	0.0003
Phytoplankton	0.002
Zooplankton	0.004
Herbivorous fish	0.39
Carnivorous fish	0.89
Fish eating birds	14.2

Tasks

a) Calculate how many times the pesticide concentration in carnivorous fish ¡s greater than that in water.

b) What does this result indicate about the movement of pesticides in a food chain?

c) Explain why the concentration of the pesticide increases from water to top consumers.

d) Using the information in the scenario, explain how the use of chemical pesticides can upset an ecosystem and Suggest three characteristics of a good pesticide that would minimize environmental damage.

Item 6

Kidepo National Park is home to two kob species that occupy different habitats. Species A lives in open savannahs with thick vegetation, where Predators such as lions chase prey at high speeds. Species B lives in swampy lowlands with dense vegetation, where movement is restricted, but food is plentiful. Park rangers noticed that the two species show striking differences in body structure and physiology, influencing their survival rates against predators.

Research Data

Trait	Species A	Species B
Leg length (cm)	95	70
Lung surface area (cm^2)	420	310
Heart rate at rest (beats/min)	60	75
Predation escape success (%)	90	65

Task:

a) Explain how the traits of each species are evolutionary adaptations to their specific habitats.

b) Analyse how these differences improve chances of survival and reproduction.

c) Suggest conservation strategies to protect these antelope species under increasing human encroachment

It's not done until it's done

END