Name……………………………………………………………………….Sign…………..

JINJA MODERN SENIOR SECONDARY SCHOOL

Uganda Advanced Certificate of Education

MID-TERM 1 ASSESSMENT 2026

S.6 BIOLOGY

PAPER 1

TIME: 3 HOURS

INSTRUCTIONS

- ✓ ***This paper consists of two (2) sections A and B.***
- ✓ ***Section A is compulsory.***
- ✓ ***Attempt two items from section B, one from each part.***
- ✓ ***Present your answers neatly and precisely.***
- ✓ ***Illustrations where necessary shall earn you additional scores.***

SECTION A

Attempt all items in this section

Item 1

In a certain week at school, teachers observed that many students experience fatigue, dizziness, and poor concentration during morning classes and sports activities. A health team investigated the possible biological causes, focusing on diet and cellular energy production.

Two groups of students (aged 15–17) were studied over two weeks Group X Students consuming a balanced diet including beans, groundnuts, millet, vegetables. While group Y students consuming mainly cassava and tea with low protein and low micronutrient diet.

After a 10-minute run, the following data were recorded:

Parameter	***Group X***	***Group Y***
Average ATP produced (arbitrary units)	95	52
Lactic acid level (mg/dm³)	18	45
Recovery time (minutes)	5	15
Oxygen consumption rate (cm^3/min	85	40

Tasks

(a) Explain the differences between Group X and Group Y leading to the observed symptoms.

(b) Explain how the low nutrients in the diet of Group Y students affects energy production.

(c) Suggest dietary and biological strategies that the school can implement to improve students' energy production and reduce fatigue.

Item 2

Farmers in Mbale obtain food and income for survival from maize. However, this season they observed that their maize crops grew poorly during a prolonged dry season. Some plots had stunted plants with yellowing leaves, while others appeared healthy. Further observations revealed that Plot B plants had smaller, thicker leaves and deeper root systems compared to Plot A. An agricultural extension officer investigated and measured key physiological parameters of the maize plants in two plots:

Parameter	***Plot A (Irrigated + balanced soil)***	***Plot B (Rain-fed, dry soil)***
Leaf stomatal conductance (mmol m^{-2} s^{-1})	320	120
Photosynthetic rate (μmol CO_2 m^{-2} s^{-1})	18	6
Relative water content (%)	82	45
Leaf area index	4.5	2.0

Tasks

(a) Explain why maize plants in Plot B have lower photosynthetic rates and smaller leaf area.

(b) Explain how the structural adaptations of Plot B plants help them survive in dry conditions.

(c) Explain the interventions farmers could implement to improve maize yield during dry seasons.

SECTION B

Attempt two items from this section

Part I

Select one item from this part

Item 3

During sports activities in a rural village school, several children were reported to feel dizzy, weak, and short of breath. Some also experienced rapid heartbeat and occasional fainting. A local health worker decided to investigate possible causes related to circulation, oxygen transport, and homeostasis. Additional observations showed that Group N children often felt dizzy during lessons and had pale mucous membranes. Two groups of children (aged 12–15) were studied:

- Group M: Children consuming a balanced diet with iron-rich foods (beans, spinach, eggs)
- Group N: Children consuming mainly cassava and tea, low in iron

The following data were collected at rest and after 5 minutes of running:

Parameter	***Group M***	***Group N***
Resting heart rate (beats/min)	72	90
Heart rate after exercise (beats/min)	110	145
Blood haemoglobin concentration (g/dl)	14	9
Blood oxygen saturation (%)	98	85
Recovery time to resting heart rate (minutes)	3	12

Tasks

(a) Analyze the data and explain the physiological reasons for the observed changes between Group M and Group N.

(b) How does low haemoglobin levels and iron deficiency affect oxygen transport and tissue function in Group N children?

(c) Suggest practical dietary and biological strategies that can be implemented at the school or household level to improve the overall health of the children.

Item 4

In a school in Kitgum, teachers observed that several students frequently experience headaches, rapid heartbeat, excessive sweating, and dizziness during afternoon classes, especially on hot days. A health team suspected that these symptoms were linked to stress, dehydration, and poor temperature regulation affecting the nervous and homeostatic systems.

Two groups of students (aged 13–16) were monitored for two weeks under classroom conditions. Students in Group R are encouraged to drink water regularly, rest during breaks, and eat balanced meals. In Group S, students drinking little water, skipping meals, and studying continuously with minimal breaks. These students reported thirst, irritability, and difficulty concentrating during lessons. The following physiological data were recorded after 30 minutes of classroom activity in hot conditions:

Parameter	*Group R*	*Group S*
Heart rate (beats/min)	78	115
Blood pressure (mmHg)	110/70	140/95
Core body temperature (°C)	36.8	38.5
Sweating rate (ml/30 min)	80	150
Recovery time to normal heart rate (min)	3	15

Tasks:

(a) Analyze and explain the physiological reasons for the differences in the observed parameters between Group R and Group S.

(b) Explain how dehydration and heat stress affect the nervous system and homeostatic mechanisms in Group S students.

(c) Which strategies at school and household levels can maintain homeostasis, prevent heat-related stress, and improve students' concentration and overall health.

Part II

Select one item from this part.

Item 5

In Gulu, farmers noticed that some of their cassava and mango plants were growing slowly, with small stems and limited branching, while others exhibited thick stems and vigorous growth. At the same time, insect pests (caterpillars of the maize stalk borer) were damaging crops, showing rapid growth and high survival rates on certain plots. A team of agricultural scientists conducted an investigation.

Mango trees were observed over a growing season. Measurements of stem diameter, branching patterns, and bark thickness were recorded. Soil nutrients were similar across plots. Some trees were treated with a synthetic auxin and gibberellin mixture, while others were untreated.

Caterpillars from the maize stalk borer were reared under two conditions. Group 1 were exposed to natural plant hormones through diet (phytohormone residues) but Group 2 were exposed to an insect growth regulator (IGR) in low doses designed to interfere with hormonal control of metamorphosis. The following data were recorded:

Parameter	*Treated mango trees*	*Untreated mango trees*	*Caterpillars Group 1*	*Caterpillars Group 2*
Stem diameter growth (cm/year)	4.5	2.0	–	–
Bark thickness (mm)	8.0	4.0	–	–
Average larval period (days)	–	–	18	28
Pupation success (%)	–	–	90	40
Adult emergence (%)	–	–	85	35

Tasks

(a) Explain the differences in secondary growth of treated and untreated mango trees.

(b) Explain how hormones regulate insect metamorphosis and why exposure to insect growth regulators in Group 2 led to observed results.

(c) State suitable strategies for the village farmers to enhance crop growth and pest control.

Item 6

Smallholder farmers in a rural district noticed that their cassava, maize, and vegetable crops were increasingly damaged by an invasive weed, *Parthenium hysterophorus*, and that native pollinators were declining. At the same time, urban markets reported higher food prices and increased transport-related emissions due to longer supply chains.

A research team studied the situation over a growing season. Crop yields (tons/ha) were measured in plots invaded by *Parthenium* and in weed-free plots. Carbon emissions (kg CO_2 eq/ha) were estimated based on farming and transport practices. Pollinator abundance was recorded to assess impacts on fruit and vegetable production. The information was given in the table below.

Parameter	***Invasive weed plots***	***Weed-free plots***
Maize yield (tons/ha)	1.2	3.0
Vegetable yield (tons/ha)	0.8	2.5
Carbon emissions (kg CO_2 eq/ha)	1500	1200
Pollinator abundance (number/plot)	12	45

The *Parthenium* was also seen to spread rapidly along irrigation channels and farm boundaries. Farmers who removed the weeds manually or used biological control agents saw partial recovery of yields and pollinator numbers.

Tasks:

(a) How does the invasive weed affect crop yields, pollinator abundance, and food security?

(b) Explain how the presence of invasive species contributes to increased carbon footprint in food production and transport.

(c) What can be done to manage invasive species, enhance food security, and reduce carbon emissions at the farm and community levels?

END