ST.PETERS HIGH SCHOOL BUSABALA

COMPETENCE BASED ASSESSMENT 2026

BEGINNING OF TERM 111 EXAMS 2026

S.5 BIOLOGY 1

Time: 2 hours

NAME …….. SIGN……..

Instructions to Candidates

- This paper consists of **Section A and Section B**.
- Answer **all items in Section A**.
- In Section B, answer **one item only**.
- Use the information provided in the scenarios and tables to support your answers.
- Give appropriate biological explanations for your answers.

SECTION A

Respond to both items in this section.

ITEM 1

A secondary school in **Mbale District** introduced an intensive athletics training programme to prepare Senior Five students for an inter-school competition. After several weeks of training, the sports department noticed that some students could run for long periods without severe fatigue, while others experienced rapid muscle fatigue, breathlessness and reduced running endurance.

The biology department investigated whether differences in the cellular structures involved in aerobic respiration could explain the differences in performance. Muscle cells from two groups of students were examined. **Group A** consisted of students who showed good endurance, while **Group B** consisted of students who frequently experienced severe fatigue during prolonged exercise.

The investigators obtained the following results.

Table 1: Cellular and respiratory characteristics of the two groups

Parameter	Group A	Group B
Functional mitochondria per muscle cell	320	145
Average mitochondrial cristae surface area (μm²)	185	82
Oxygen consumption (μmol O_2 min^{-1} g^{-1} muscle)	48	21
ATP concentration (mmol kg^{-1} muscle)	5.8	2.6
Lactate concentration in blood (mmol L^{-1})	1.8	9.6
Average running endurance (minutes)	54	27

Further investigation showed that students in Group B had a relatively poor supply of oxygen to their muscles during strenuous exercise.

Tasks

(a) Analyse the data to explain how differences in cellular structures and respiratory processes contributed to muscle fatigue and reduced endurance among the students.

(b) Evaluate strategies that could be adopted by the school to improve energy production and reduce exercise-related fatigue among the students, and give strategic guidance.

ITEM 2

A commercial farmer in **Luwero District** planted maize on three sections of the same farm. Although the sections received similar amounts of rainfall and sunlight, considerable differences were observed in plant growth and grain production.

Plants in one section had broad, dark-green leaves and well-developed cobs. Plants in another section were short with pale-green leaves, while plants in the third section showed yellowing between the veins of older leaves.

Agricultural scientists suspected that the differences were associated with **mineral nutrition and photosynthetic activity**. They analysed plants from the three sections.

Table 2: Effect of mineral nutrient availability on maize productivity

Parameter	Plot A – Adequate nutrients	Plot B – Nitrogen deficient	Plot C – Magnesium deficient
Chlorophyll content (SPAD units)	48	24	19
Average plant height (cm)	185	121	108
Average leaf area (cm^2)	620	385	340
Photosynthetic rate ($\mu mol\ CO_2\ m^{-2}\ s^{-1}$)	24.5	13.2	10.8
Grain yield (tons ha^{-1})	5.8	2.9	2.4
Leaf appearance	Dark green	Pale green/yellow	Yellowing between veins

The scientists explained that nitrogen is required in the synthesis of amino acids, proteins, enzymes and chlorophyll, while magnesium is an important component of the chlorophyll molecule.

The farmer proposed applying large quantities of fertiliser to all sections of the farm during the next growing season in order to maximise production.

Tasks

(a) Analyse the data to explain how nitrogen and magnesium deficiencies affected photosynthesis, plant growth and maize yield.

(b) Evaluate the farmer's proposal of applying large quantities of fertiliser and propose sustainable strategies for maintaining high crop productivity.

SECTION B

Respond to one item from this section.

ITEM 3

A health centre in **Kabale District** investigated complaints of persistent tiredness, dizziness and reduced exercise tolerance among adults involved in agricultural work. The affected individuals reported becoming exhausted after relatively short periods of digging, carrying loads and walking long distances.

The health workers suspected that poor nutrition, particularly inadequate intake of iron, could be affecting the ability of blood to transport oxygen.

Blood samples were collected from affected individuals and compared with samples from healthy adults.

Table 3: Blood and cardiovascular parameters

Parameter	Affected adults	Healthy adults
Haemoglobin concentration (g dL^{-1})	8.2	14.1
Oxygen concentration in arterial blood (mL O_2 dL^{-1})	12.0	19.8
Resting heart rate (beats min^{-1})	92	70
Resting cardiac output (L min^{-1})	5.9	4.9
Oxygen consumption during exercise (mL min^{-1})	1,250	2,100
Average exercise tolerance (minutes)	18	42

The health workers noted that many of the affected adults consumed diets low in iron-rich foods.

They proposed the following interventions:

1. Encouraging consumption of iron-rich foods such as liver, beans and dark-green vegetables.
2. Providing iron supplements to individuals confirmed to have iron deficiency.
3. Advising affected individuals to avoid strenuous physical activity completely.

Tasks

(a) Analyse the data to explain how the differences in blood and cardiovascular parameters contributed to reduced exercise tolerance among the affected adults.

(b) Evaluate the interventions proposed by the health workers and give strategic guidance for improving oxygen transport and exercise capacity in the affected community.

ITEM 4

A district hospital in **Kampala** investigated an increase in cardiovascular complications among adults living in an urban community. The health workers observed that many affected individuals had sedentary lifestyles and frequently consumed diets containing high levels of saturated fats.

Medical examination indicated that some patients had fatty deposits in the walls of major arteries. The hospital compared cardiovascular parameters between adults who maintained relatively healthy lifestyles and those who had diets high in saturated fats and low levels of physical activity.

Table 4: Cardiovascular parameters in the two groups

Parameter	Healthy lifestyle group	High-fat/inactive group
LDL cholesterol (mmol L^{-1})	2.1	4.8
Blood pressure (mmHg)	118/76	154/98
Resting heart rate (beats min^{-1})	68	86
Arterial diameter (mm)	4.6	3.1
Blood flow through major artery (mL min^{-1})	5,200	3,400
Exercise tolerance (minutes)	45	24

The hospital proposed several interventions:

- Reducing consumption of foods rich in saturated fats.
- Increasing regular moderate physical activity.
- Increasing consumption of fruits, vegetables and whole-grain foods.
- Using cholesterol-lowering medication where clinically necessary.

Tasks

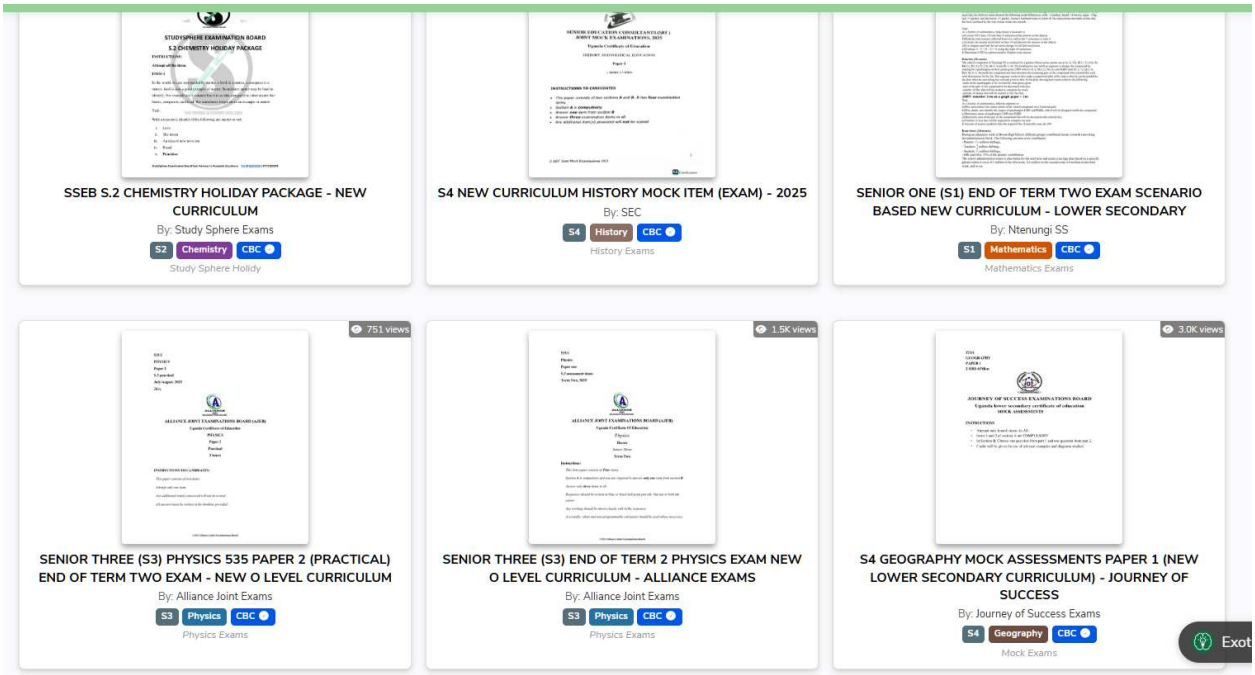
(a) Analyse the data to explain how changes in blood composition and arterial structure affected circulation and exercise tolerance among the affected adults.

(b) Evaluate the proposed interventions for reducing cardiovascular complications and give strategic guidance on the most sustainable approach for the community.

END

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