**Student's Name:**.....

**Signature**.....

| Random No. | | | | | | Personal No. | | |
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**BIOLOGY**
**PAPER 1**
**(Theory)**
**3 Hours**

BIOCLASS HUB

**PRE-REGISTRATION EXAMINATIONS 2026**

**BIOLOGY**

**Paper 1**

**(Theory)**

**3 HOURS**

**INSTRUCTTIONS TO CANDIDATES:**

*This paper consists of* **two** *sections:* **A** *and* **B.** *It has* **SIX** *examination items.*

*Section* **A** *has* **Two Compulsory** *items.*

*Section* **B** *has* **FOUR** *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* **FOUR** *items in all.*

*Any additional item(s) answered will* **not** *be scored*



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**SECTION A**

**Attempt all the items in this section**

**ITEM 1**

A rural community started a small cassava flour processing factory to improve food security. After six months, workers began complaining of headaches, dizziness, and muscle weakness. Some fish in a nearby stream were also found dead.

The factory uses crushed cassava soaked in water before drying. During processing, a bitter smell similar to almonds was noticed. The wastewater from the factory is discharged into the stream.

Further laboratory tests produced the following results:

| **Parameter** | **Normal fish** | **Fish near factory** |
|---|---|---|
| Dissolved oxygen (mg/L) | 9.0 | 3.5 |
| ATP per mitochondrion | 28 | 12 |
| Cytochrome c oxidase activity (%) | 100 | 30 |
| Rate of glycolysis | Normal | Increased |
| Mutation rate in liver cells (%) | 2 | 18 |

Additional findings:

- Cyanide was detected in wastewater.
- High temperature recorded in discharged water.
- Fish gill epithelial cells showed damaged plasma membranes.
- Ribosomes in liver cells appeared detached from rough ER.

**Task**

**(a)** Explain how the factory wastewater disrupts fish cell function by affecting mitochondrial structure and ATP production, inhibiting enzymes, damaging plasma membranes, and increasing DNA mutation rates through impaired protein synthesis.



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**(b)** Suggest practical measures to reduce environmental harm and protect human and aquatic health while sustaining cassava production.



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**ITEM 2**

Tea farmers in Kabale pruned their plants heavily just before the cold season to increase branching. However, after pruning, plants showed slow recovery, smaller leaves, and delayed flowering.

Kabale experiences cool temperatures (14–16°C), frequent fog, and shorter daylight hours during this period.

Data collected:

| **Parameter** | **Before Pruning** | **After Pruning (Cold Season)** |
|---|---|---|
| Leaf area | Large | Small |
| $CO_2$ uptake | Moderate | Low |
| Chloroplast activity | Normal | Reduced |
| Gibberellin level | Moderate | Low |
| Cytokinin level | Moderate | Low |
| Growth rate | Moderate | Very slow |

**Task**

**(a)** Explain how low temperature combined with pruning affects photosynthesis, hormone balance, primary growth, and photoperiod response.



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**(b)** Using plant growth principles, explain how pruning and seasonal management should be adjusted to improve yield.

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## SECTION B
## Part I
## Attempt one item from this section

**ITEM 3**

At a secondary school in Mbale (Altitude 1,200 m), students participated in a tree-planting exercise near a busy roadside. After several hours, four students showed unusual signs.

• Musa felt dizzy and had a headache.
• Lillian developed itchy eyes and sneezing.
• Tom reacted slowly when called and staggered slightly.
• Aisha complained of blurred vision in dim light.

The health club recorded the following:

| Parameter | Musa | Lillian | Tom | Aisha | Normal |
|---|---|---|---|---|---|
| Blood oxygen saturation (%) | 82 | 96 | 88 | 95 | 95–100 |
| Carboxyhaemoglobin (%) | 18 | 1 | 10 | 1 | <2 |
| Heart rate (beats/min) | 120 | 90 | 110 | 85 | 70–100 |
| Reaction time (s) | 0.32 | 0.19 | 0.30 | 0.18 | 0.18 |
| Tear secretion | Normal | High | Normal | Normal | Normal |
| Rod cell response (retina test) | Normal | Normal | Normal | Low | Normal |

Later it was discovered that traffic had been heavy and some students had not eaten or drunk water all morning.

**TASK**

**(a)** Using the data, explain how carbon monoxide exposure, dehydration, allergic reactions, and sensory receptor function affected the students' oxygen transport, heart activity, nervous coordination, and vision.

**(b)** Suggest practical strategies to prevent such conditions during outdoor school activities.

**ITEM 4**

During a school mountain hiking trip to the slopes of Mount Elgon (elevation 3000 m), students participated in a survival challenge. The weather was cold (10 °C), and the air was thin.

Two students, Musa and Joel, showed unusual responses:

- Musa complained of headache and dizziness. His lips appeared slightly blue.
- Joel fainted briefly near a charcoal stove used for cooking inside a tent.
- Both had increased breathing rates.
- Later that night, some students developed itchy rashes after eating packed groundnuts.
- One student, Aisha, had recently received a tetanus booster vaccine.
- Rapid malaria test kits were used on two febrile students and were negative.

The teacher recorded the following:



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| Parameter | Musa | Joel |
|---|---|---|
| Breathing rate (breaths/min) | 30 | 28 |
| Pulse rate (beats/min) | 120 | 130 |
| Blood oxygen saturation (%) | 82 | 78 |
| Carboxyhaemoglobin level (%) | 2 | 25 |
| Core body temperature (°C) | 35.5 | 36.8 |
| Urine output | Low | Normal |

The school nurse suspected problems related to oxygen transport, temperature regulation, immunity, and nerve function.

**TASK**

**(a)** Analyse the physiological causes of Musa's and Joel's symptoms by linking oxygen dissociation, haemoglobin function, carbon monoxide effects, nervous and hormonal control of heart rate, hypothalamic temperature regulation, histamine action, vaccination, and rapid test kit mechanisms.

**(b)** Propose biologically justified preventive and management strategies for future mountain hikes.

## PART II

## Attempt one item from this section

**ITEM 6**

In the bean-growing regions of eastern Uganda, farmers are battling an outbreak of black bean aphids (*Aphis fabae*). A researcher from Makerere University found that the aphids exist in two main strains: one that is resistant to a common pyrethroid pesticide, and one that is susceptible. The resistance is controlled by a dominant allele (R). The aphids also vary in their colour: some are shiny black, while others are dull brown. The colour is controlled by a separate gene (B for black, dominant over b for brown). The researcher performed a cross between a true-breeding resistant, black aphid and a true-breeding susceptible, brown aphid. The F1 generation were all resistant and black. However, when these F1 males were crossed with susceptible, brown females (a test cross), the offspring were not in a 1:1:1:1 ratio. The 500 offspring produced were:

- Resistant, Black: 205
- Resistant, Brown: 45
- Susceptible, Black: 48
- Susceptible, Brown: 202

The researcher also noted that ladybird beetles (a natural predator of aphids) prefer to eat the brown aphids, as they are more visible against the green bean leaves.

**Task:** Analyse the genetic data from the test cross to explain the inheritance pattern of the resistance and colour genes, predict how the interaction between pesticide use and predator preference will affect the allele and phenotype frequencies in the aphid population over time, and propose an integrated pest management strategy for farmers that combines chemical and biological controls sustainably.



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**ITEM 7**

In the rice-growing region of Jinja District, farmers have noticed that brown planthoppers are causing reduced yields despite pesticide application. Observations include:

- Some planthoppers carry alleles for pesticide resistance showing incomplete dominance.
- Resistant allele frequency increased from 10% to 55% over four years.
- Paddy fields with high bird populations report fewer planthoppers, while frog populations have declined.
- Waterlogged fields favour planthopper nymph survival, increasing over the wet season.
- Some planters practice crop rotation; others leave paddies fallow.

**Task:** Analyse the genetic, ecological, and population factors contributing to the increase in pesticide-resistant planthoppers and propose a sustainable, biologically informed pest management strategy for Jinja rice fields.

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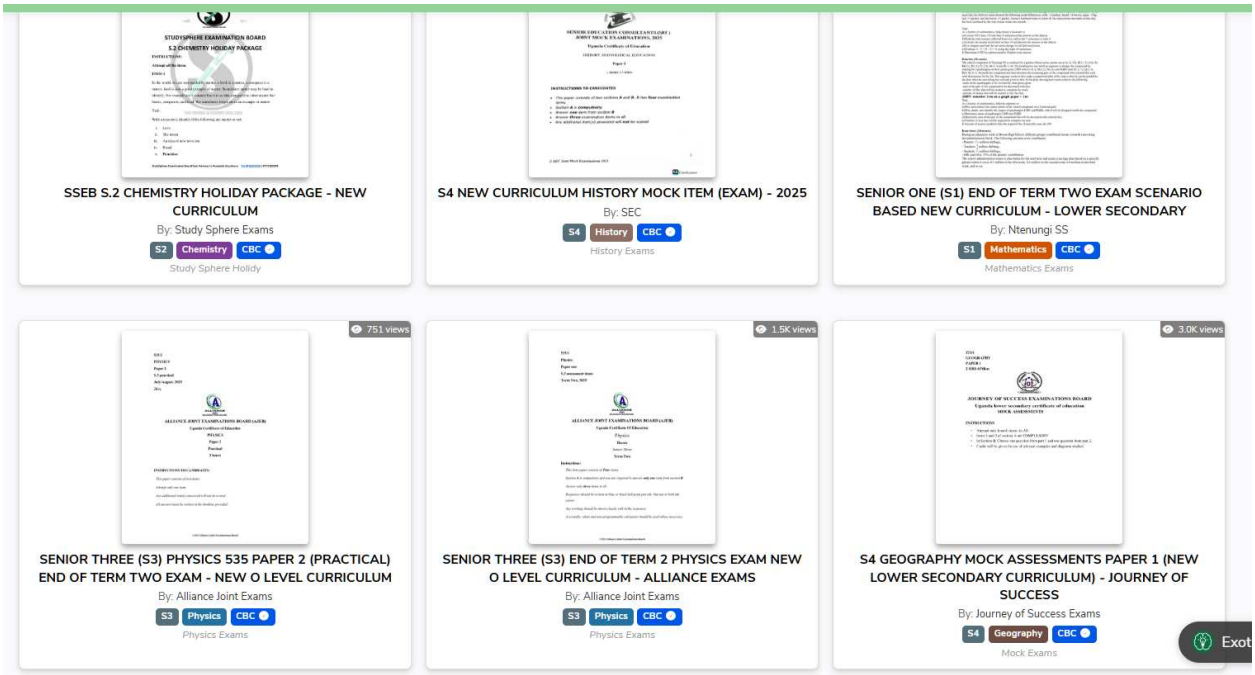
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