WAKISSHA MOCK EXAMINATIONS, 2026
RESPONSES TO UCE BIO 553/1
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SECTION A

Respond to all the items in this section in the spaces provided.

Item 1

A study was conducted in a semi-arid savannah ecosystem to investigate how plants survive under extreme environmental stress. They observed that some parts of the study area experienced very high temperatures, intense sunlight, low soil moisture, high rates of evaporation, and sandy soils with low nutrient content, particularly nitrogen.

In this environment, several plant species such as acacias (leguminous plants) were thriving. Some plants had small needle-like leaves, while others had thick fleshy stems. A number of plants showed deep tap-root systems, while others had widely spread shallow roots close to the soil surface. The legumes had reduced leaf surface area and waxy cuticles; they maintained relatively healthy growth despite the harsh conditions.

The scientists also observed that many plants had stomata that remained closed during the day but opened at night, and some leaves showed a folded structure during peak heat hours.

The ecologists were interested in how the plant species managed to adapt and compete successfully in such a challenging environment.

Task:

(a) Identify the plant structures whose functioning was being affected by the environmental conditions in this semi-arid ecosystem.

The harsh environmental conditions in the semi-arid ecosystem mainly affected the following plant structures:

- ***Leaves***
- ***Roots***
- ***Stems***
- ***Stomata***

(b) Explain how the environmental conditions in the scenario affected the processes of the plants.

- ***High temperatures, intense sunlight, and low humidity increased transpiration, causing excessive water loss from the leaves and reducing the water available for physiological processes such as photosynthesis and cell turgidity.***
- ***Low soil moisture reduced water absorption by roots, limiting the supply of water to leaves and consequently reducing photosynthesis and other metabolic processes.***
- ***Low soil nitrogen reduced nitrogen uptake, limiting the synthesis of amino acids, proteins, and chlorophyll, thereby reducing enzyme production, photosynthetic activity, and plant growth.***

- ***High rates of evaporation rapidly depleted soil water, intensifying water stress and further reducing water uptake and photosynthetic activity.***

(c) Explain how the acacia plants were able to survive and compete successfully with other plants under these conditions.

- ***Acacia plants, being legumes, possessed root nodules containing nitrogen-fixing bacteria that converted atmospheric nitrogen into usable nitrogenous compounds such as nitrates, enabling them to thrive in nitrogen-poor soils.***
- ***Waxy cuticles reduced water loss from the leaves, conserving water under the hot and dry conditions.***
- ***Deep root systems enabled the plants to access water from deeper soil layers when the surface soil was dry.***
- ***Reduced leaf surface area due to smaller leaves lowered the area available for transpiration, thereby minimising water loss.***
- ***These adaptations enabled acacias to conserve water and obtain essential nutrients, allowing them to maintain growth and compete successfully under the harsh environmental conditions.***

Item 2

In Lufunda Parish, a rural farming community, the local health centre has reported a rising number of chronic health conditions affecting both adults and youth. During a medical outreach program, health workers observed the following: -

- ❖ Many adults, especially those above 45 years, are suffering from weak bones, frequent fractures, and persistent back pain (osteoporosis).
- ❖ Many women and children have visible swelling at the front of the neck (Goitre).
- ❖ Several middle-aged individuals were diagnosed with diabetes mellitus.
- ❖ Many youths frequently consume alcohol, tobacco, and other substances.
- ❖ Some patients also showed reduced sensitivity to environmental stimuli such as light and sound due to prolonged substance abuse.

The medical team confirmed that the conditions were linked to hormonal imbalance, enzyme inefficiency, poor diet, and substance abuse affecting their body systems. Clinical tests confirmed diabetes, goiter, and osteoporosis.

Task:

(a) Explain how hormonal imbalance contributes to the development of diabetes, goiter and osteoporosis in the individuals of Lufunda Parish.

- ***Insufficient insulin production by the pancreas or reduced sensitivity of body cells to insulin reduces glucose uptake, causing glucose to accumulate in the blood and resulting in diabetes mellitus, with symptoms such as excessive thirst, fatigue, and frequent urination.***
- ***Iodine deficiency limits the production of thyroid hormones. This stimulates increased secretion of thyroid-stimulating hormone (TSH) by the pituitary gland, causing enlargement of the thyroid gland and the neck swelling observed among the women and children, resulting in goitre.***
- ***Reduced oestrogen levels, especially in older women, can increase bone resorption and reduce bone mineral density, making bones weak and prone to the frequent fractures observed among adults, a condition called osteoporosis.***

(b) Explain how reduced enzyme activity affected nutrient absorption and overall health of the Lufunda people.

- ***Reduced enzyme activity limits the breakdown of food into absorbable molecules, reducing nutrient absorption in the small intestine and causing nutritional deficiencies and increased susceptibility to diseases.***
- ***Poor digestion and absorption of glucose can reduce energy production, while inadequate absorption of calcium and proteins can weaken bones and impair tissue maintenance, resulting in general body weakness.***

(c) Discuss the role of diet and lifestyle in the prevention and management of the disorders identified in the community.

Diet and lifestyle play a critical role in both the prevention and management of the disorders observed in the community.

- ***A balanced diet rich in iodine can prevent goitre by supporting normal thyroxine hormone synthesis.***
- ***Adequate intake of calcium and vitamin D is essential for maintaining strong bones and reducing the risk of osteoporosis and fractures.***
- ***For diabetes management, limiting refined sugars and consuming fibre-rich foods such as green vegetables, beans and fruits slows the digestion and absorption of carbohydrates, thereby reducing rapid rises in blood glucose levels.***
- ***Proper nutrition provides nutrients required for enzyme production, such as amino acids from protein-rich foods, and supports normal metabolism and overall body functioning.***
- ***Regular physical exercise helps strengthen bones and increases glucose uptake by body cells, supporting bone health and blood glucose control.***

Item 3

A couple living with HIV has three children with normal vision; however, the fourth child, a boy, was found to have difficulty in distinguishing between red and green colours. This caused concern to the parents since neither of them had any noticeable vision problems. After a medical examination, the doctor diagnosed the child with red-green colour blindness, a genetic condition linked to the X-chromosome. The doctor reassured them that the child could live a normal life with proper support.

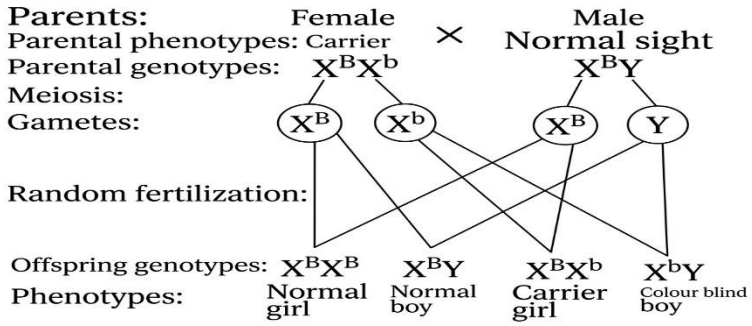
Task:

(a) Using genetic symbols, show how the condition in their fourth child came about.

Let B represent the allele for normal colour vision

b represent the allele for colour blindness

Since both parents had normal colour vision and produced a colour blind boy, the mother must have been a carrier of the allele for colour blindness (heterozygous).



The fourth-born boy inherited the colour-blindness allele X^b from his carrier mother and the Y chromosome from his father, giving him the genotype X^bY.

(b) Explain how the couple can;

(i) Continue living positively with their health status.

To continue living positively with their HIV status, the couple should:

- ***Adhere strictly to antiretroviral therapy to maintain a strong immune system and reduce the viral load.***
- ***Attend regular medical check-ups to monitor their health status.***
- ***Maintain a balanced diet, practise good hygiene and seek psychosocial support to manage stress and stigma.***
- ***Maintain open communication between partners and consistently use preventive measures to reduce transmission risks and improve their quality of life.***

(ii) Take care of their fourth-born child.

To take care of their fourth-born child, the parents should:

- ***Support him in adapting to his condition by informing teachers about his colour-vision difficulty so that learning materials can be appropriately adjusted.***
- ***Encourage the use of labels, patterns or positions rather than colour alone for identification.***
- ***Provide emotional support to build his confidence.***
- ***Arrange regular eye check-ups to monitor his vision.***
- ***Use special glasses or filter lenses where appropriate to enhance colour contrast.***
- ***Use mobile applications that can identify or pronounce colours.***

SECTION B

Part I

Respond to only one item from this part.

Responses should be written in the answer booklet(s) provided.

Item 4

Residents of Kayanja Village depended on a nearby wetland for clean water, fishing, and harvesting papyrus for making mats and baskets. The wetland also supported a wide variety of birds and insects and helped regulate flooding during the rainy season. Over time, a real estate developer drained a large portion of the wetland and filled it with sand to construct residential houses. In addition, wastewater from houses was directed into a small channel that originally fed the wetland.

After a few years, residents began to notice reduced fish populations, frequent flooding during heavy rains, foul-smelling water, and an increase in waterborne diseases.

Task:

(a) Explain how the developer's activities lead to the loss of the benefits previously obtained from the wetland by both the environment and the residents.

The developer's activities disrupted the natural structure and functioning of the wetland, leading to the loss of its ecological and socio-economic benefits.

- ***Draining and filling the wetland with sand destroyed habitats and breeding grounds for fish, birds, and insects, leading to a decline in fish populations and biodiversity.***
- ***Wastewater directed into the channel polluted the wetland. This reduced its ability to naturally filter and break down pollutants, resulting in foul-smelling water and an increased risk of waterborne diseases among the residents.***
- ***The wetland naturally absorbed excess rainwater and released it gradually, thereby regulating water flow and reducing flooding. Draining and constructing on the wetland reduced this capacity, resulting in frequent flooding during heavy rains.***
- ***The destruction of papyrus reduced the availability of raw materials for making mats and baskets, thereby reducing sources of income and affecting the livelihoods of the residents.***

(b) Suggest the importance of conserving wetlands like the one described in the scenario.

Conserving wetlands like the one described is important because they:

- ***Provide raw materials such as papyrus for making mats, baskets and other products, supporting household income and livelihoods.***
- ***Provide habitats and breeding grounds for fish, birds, insects and other organisms, thereby maintaining biodiversity.***
- ***Support fisheries by providing suitable habitats and breeding grounds for fish, which provide food and income to communities.***
- ***Improve water quality through natural filtration, as wetland vegetation and soils trap sediments and remove or retain some pollutants.***
- ***Control flooding by absorbing excess rainwater and releasing it gradually.***
- ***Recharge groundwater by allowing some of the stored water to infiltrate into the ground.***
- ***Contribute to climate regulation by storing carbon in wetland vegetation and soils.***
- ***Support vegetation that contributes to oxygen production and carbon dioxide uptake through photosynthesis.***

Item 5

The Uganda Wildlife Authority conducted a study in Murchison Falls National Park and surrounding communities to assess the impact of increasing human activities on Wildlife population and ecosystem stability.

Over the past five years, there has been expansion of farmland into protected areas, increased poaching of herbivores such as antelopes, charcoal burning, and deforestation near Park boundaries.

At the same time, communities have reported rising cases of crop destruction by antelopes, increased attacks on livestock by lions, and reduced fish catch from the nearby water bodies.

The table below shows changes in wildlife population, fish, and human activities (2016-2020).

Year	Antelope population	Lion population	Poaching Cases	Fish Population
2016	12,000	320	80	70
2017	11,200	310	110	65
2018	10,060	290	150	55
2019	8,800	270	210	40
2020	7,500	212	260	32

The changes in fish population were linked to industrial discharge and sedimentation from farming.

Task:

(a) Explain the effect of human activities on the ecosystem.

- ***Poaching reduced the antelope population from 12,000 in 2016 to 7,500 in 2020, disrupting food chains by reducing prey availability for lions. This contributed to the decline in the lion population from 320 to 212 and may have forced some lions to attack livestock, increasing human-wildlife conflict.***
- ***Deforestation, charcoal burning, and expansion of farmland destroyed and fragmented wildlife habitats, reducing available food, shelter, and breeding sites and contributing to the decline in wildlife populations and biodiversity.***
- ***Habitat destruction reduced the carrying capacity of the ecosystem, forcing some wildlife into surrounding communities in search of food and shelter, thereby increasing crop destruction and livestock attacks.***
- ***Industrial discharge and sedimentation from farming polluted water bodies and reduced water quality, contributing to the decline in fish population from 70 in 2016 to 32 in 2020.***
- ***The increase in poaching cases from 80 in 2016 to 260 in 2020, together with habitat destruction and water pollution, disrupted food chains and reduced ecosystem stability and natural functioning.***

(b) Explain how these changes hinder Social-economic development.

These environmental changes hinder socio-economic development by:

- ***Reducing wildlife populations and biodiversity, which can lower the attractiveness of the area for tourism and reduce tourism-related revenue and employment.***
- ***Reducing fish populations and catches, thereby lowering sources of food, income and employment for communities that depend on fishing.***
- ***Increasing human-wildlife conflict through crop destruction and livestock attacks, resulting in loss of food, property and income and increasing insecurity among communities.***
- ***Reducing agricultural productivity when wildlife destroys crops, thereby contributing to food insecurity and reduced household income.***
- ***Degrading natural resources needed to support livelihoods and long-term economic activities, thereby undermining sustainable development.***

(c) Suggest solutions to the challenges and benefits of implementing the solutions.

The challenges can be addressed through the following measures:

- ***Strengthen anti-poaching laws and enforcement to reduce illegal hunting, allowing wildlife populations to recover and supporting tourism.***
- ***Promote community-based conservation programmes that involve local communities in protecting and restoring wildlife habitats, thereby improving biodiversity and providing conservation-related benefits to communities.***
- ***Regulate the discharge of industrial waste into water bodies and control soil erosion and sedimentation from farms to improve water quality and support the recovery of fish populations.***
- ***Promote sustainable agricultural practices and establish appropriate buffer zones around protected areas to reduce habitat destruction and human-wildlife conflict.***
- ***Develop alternative livelihoods such as beekeeping, eco-tourism and other sustainable enterprises to reduce dependence on activities that degrade wildlife habitats and natural resources.***
- ***Strengthen community awareness and wildlife-management programmes to promote coexistence between local communities and wildlife.***

Part II

Respond to only one item from this part.

Item 6

Sarah, a 16-year-old student, for several weeks experienced frequent urination, excessive thirst, tiredness, blurred vision, and unexplained weight loss. One morning at school, she fainted during assembly and was rushed to a nearby health centre. The health worker suspected diabetes and tested Sarah's blood glucose level before and after she ate a meal. Her urine was also tested for glucose and proteins. Table 1 shows Sarah's Blood glucose levels.

Table 1: Sarah's Blood glucose levels

Time	Blood glucose levels mmol/l
Before meal	12.5
1 hour after meal	19.8
2 hours after meal	17.6
4 hours after meal	14.2

Urine test results showed absence of proteins and presence of glucose; and the normal fasting glucose level is 4-6 mmol/l.

Task:

(a) (i) Using the information in the scenario and data in Table 1, explain why the health worker suspected diabetes.

The health worker suspected diabetes because:

- ***Sarah presented characteristic symptoms of diabetes, including frequent urination, excessive thirst, tiredness, blurred vision, and unexplained weight loss.***
- ***Her fasting blood glucose level was 12.5 mmol/L, which was much higher than the normal range of 4–6 mmol/L. Her blood glucose also remained abnormally high after the meal, rising to 19.8 mmol/L after one hour and remaining at 14.2 mmol/L even after four hours, indicating poor regulation of blood glucose.***
- ***Glucose was present in her urine, showing that the blood glucose concentration had risen above the kidney's capacity to reabsorb all the filtered glucose.***

(ii) Explain how diabetes affected the functioning of Sarah's body.

- ***Insufficient insulin production or reduced sensitivity of body cells to insulin prevented efficient uptake of glucose by cells, leaving excessive glucose in the blood. This reduced the availability of glucose for cellular respiration and energy production, resulting in general body weakness and tiredness.***
- ***Excess glucose in the blood increased the amount of glucose filtered into the urine, causing osmotic loss of water with the urine. This resulted in frequent urination and dehydration, causing excessive thirst.***
- ***Because cells could not obtain sufficient glucose for energy, the body increased the breakdown of stored fats and proteins, contributing to unexplained weight loss.***
- ***Persistently high blood glucose can affect the normal functioning of the eyes, causing blurred vision, and may damage body organs and tissues if not controlled.***

(b) Suggest suitable ways Sarah can manage her condition without being referred to another hospital and explain what may happen to Sarah if the condition is NOT managed properly.

Sarah can manage her condition by:

- ***Taking regular, balanced meals in appropriate portions, such as vegetables, whole-grain foods, beans and other protein-rich foods, while limiting sugary foods and drinks, to help maintain stable blood glucose levels.***
- ***Engaging in regular physical activity, as appropriate for her condition, to increase glucose uptake by body cells and improve blood glucose control.***
- ***Monitoring her blood glucose regularly, maintaining adequate hydration, and taking any medication prescribed by the health worker.***
- ***Learning about diabetes and receiving support from her family to encourage adherence to treatment and healthy lifestyle practices.***

If the condition is not properly managed, Sarah may develop complications such as:

- ***Damage to the blood vessels of the eyes, which may impair vision.***
- ***Kidney damage that may progress to kidney failure.***
- ***Nerve damage, which may cause loss of sensation and other complications.***
- ***Damage to blood vessels, increasing the risk of cardiovascular complications.***
- ***Very high or very low blood glucose levels, which can cause loss of consciousness and may become life-threatening.***

Item 7

Chemongesi is a talented long-distance runner who smokes regularly. Their home is located near a swampy area. Over the past six months, Chemongesi started experiencing frequent illnesses. Medical tests later confirmed that he has developed heart and respiratory complications, alongside recurrent malaria infections. His Coach noticed a steady decline in his athletic performance and collected the following data;

Table 2: Chemongesi's monthly performance.

Month	Distance covered	Malaria episodes (number of times suffered)	Body Weight (Kg)	Lung function: lung volume (cm^3)
January	6.5	0	60	420
February	6.2	1	59	400
March	5.8	2	57	370
April	5.1	2	55	340
May	4.3	3	53	310
June	3.5	3	50	280

Task:

(a) Using the data provided, explain the decline in Chemongesi's sports performance.

Chemongesi's sports performance declined due to the combined effects of recurrent malaria, weight loss, reduced lung function, and regular smoking.

- ***Malaria episodes increased from 0 in January to 3 in May and June. Recurrent malaria caused repeated illness, fever, and recovery periods, which interrupted training and reduced his physical strength and endurance.***
- ***His body weight decreased from 60 kg in January to 50 kg in June, indicating substantial weight loss. Recurrent illness may have reduced food intake and increased the breakdown of body reserves, reducing the energy available for physical activity and recovery.***
- ***Lung volume decreased from 420 cm^3 in January to 280 cm^3 in June, indicating reduced lung function. Tar and other harmful substances in tobacco smoke can damage lung tissues, reduce lung elasticity, interfere with ciliary action and impair gaseous exchange. This reduces the efficiency of ventilation and oxygen uptake, limiting aerobic respiration and energy production during prolonged exercise.***
- ***The distance Chemongesi could cover decreased steadily from 6.5 km in January to 3.5 km in June. This indicates a marked decline in endurance and athletic performance, consistent with the effects of recurrent illness, weight loss and reduced respiratory function.***

(b) Suggest measures Chemongesi can take to manage his health condition and improve his well-being.

Chemongesi can manage his health condition and improve his well-being by:

- ***Stopping smoking to prevent further damage to the respiratory system and allow lung function to improve.***
- ***Preventing malaria by sleeping under insecticide-treated mosquito nets and reducing mosquito breeding sites, such as stagnant water around the home.***
- ***Seeking prompt medical attention and completing prescribed treatment whenever malaria or other illness occurs.***

- ***Eating a balanced diet containing adequate carbohydrates, proteins, fats, vitamins, and minerals, for example, whole grains, beans, eggs, fish, fruits, and vegetables, to restore energy reserves and support tissue repair and recovery.***
- ***Engaging in gradual, supervised physical exercise and allowing adequate rest to rebuild strength and endurance without overloading the body during recovery.***
- ***Attending regular medical check-ups to monitor his heart, respiratory function, and general recovery, and following the health worker's advice.***

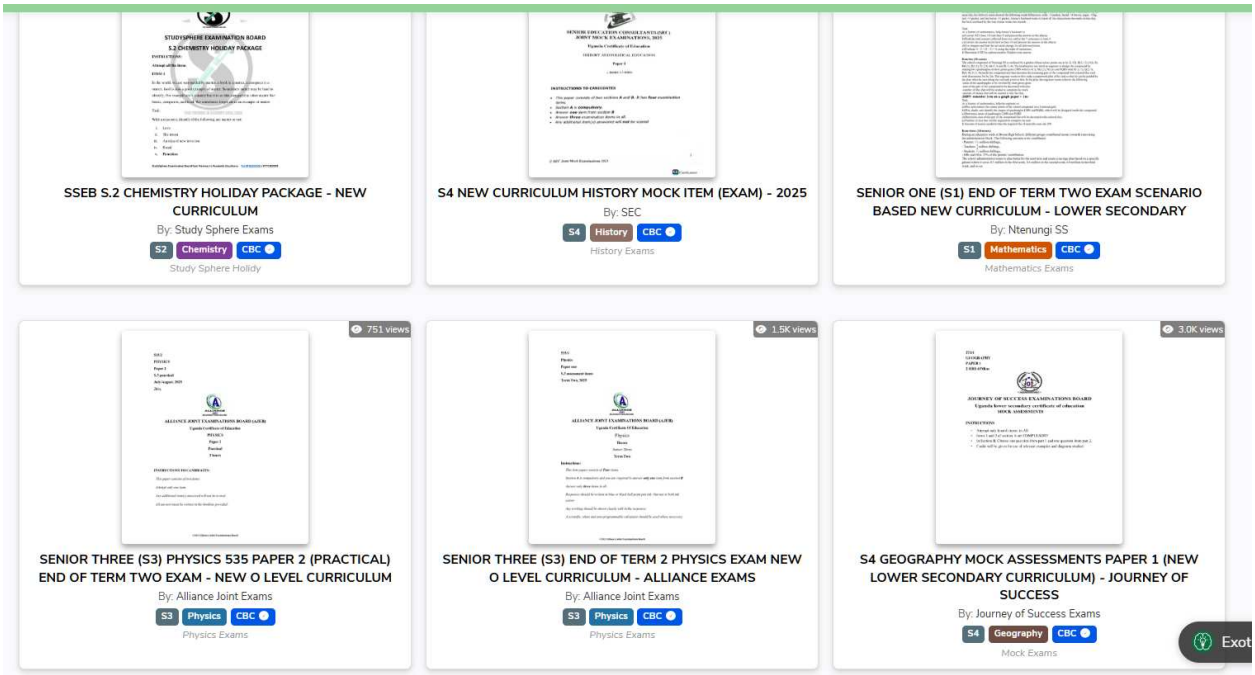
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