SCENARIO BIOLOGY (56 ITEMS)

***ITEM 1*.**

Mutyaba Gerald is a plant botanist that has been conducting a study on the effects of drought on plant growth and development. While conducting the study, he was able to notice that these plants face challenges of food scarcity and water stress. He has approached you to enable him understand how these plants overcome these challenges.
Task
As a Biology learner, help him address his concern.

Item 2
A team of environmental scientists has been tasked with designing a sustainable and self-sufficient ecosystem for a newly established research station in a remote arid region. The station will be a home to a diverse range of plant and animal species and must be able to support life for extended periods without external input. As part of the design process, the team must select a substance to serve as the primary medium for life support, temperature regulation and chemical reactions with in the ecosystem and the team has approached you for assistance.
Task
As a Biology learner, which choice would you advise them to make and why?

Item 3
A team of botanists has conducted a study on a unique species of plants and have been able to notice that the plant stems when cut, depict a structure which is long and tube-like. While on the study, they have been able to note still that this species of plants has managed to survive in the environment despite the fact that the amount of water available in the environment is less. This has left them puzzled and would wish to know more about the components of the observed structure and what enables it to support the plants in the stated environment.
Task
As a Biology learner, address the concern of this team of botanists.

Item 4

Lantana camara is an invasive weed that has become a problem in Kidepo National Park in the recent times. A group of botanists did an investigation about the factors that have led to its exponential growth and they discovered that it is allopathic(produces chemicals that deter the growth of other plants).When there was thorough investigation about the chemicals, it was discovered that the mechanism of action of the chemicals produced by Lantana camara could directly damage the cell membrane of the cells of the surrounding plants.However,they failed to understand what exact mechanism the chemicals had on the membrane and how it would affect the normal cell physiology.

Task

As a cytologist, explain to them how the damage of the cell membrane affected the growth of other native plants.

Item 5

Upon observation of a bacterium cell, Paul a S.5 student realised that the cell lacks organelles.

He's aware that the cell needs ATP energy for locomotion since it has a flagellum. Paul is also biased about all bacteria; he says that they cause diseases.

a) Which organelles was Paul meaning?

b) Help Paul to know why bacterium cell uses energy yet no organelles present?

c) Is Paul right to hate all bacteria? Suggest reasons for your response.

Item 6

There is a common statement amongst our community that "Water is life". Indeed, water is a chemical of life. As an advanced biology student;

a) suggest why do you think people say water is life

b) Draw a water molecule structure to show the property that makes it an important chemical of life.

Item 7

Musisi was carrying out an investigation to find out the different animal cells that form different tissues. He gently scratched his mouth with a toothpick, put on a slide and observed under a light microscope.

a) Using histological knowledge which;

(i) type of tissue did he observe under the microscope?

(ii) other body regions contain the tissue that Musisi observed?
b) (i) What is the role of the tissue observed in the region where they are found?
(ii) How is the tissue suited to play the role(s) you have stated in b(i) above?
c) Draw and label what Musisi observed in the microscope.

Item 8
While on her study research about cells using sophisticated microscopic techniques, Leticia always observed the structure below surrounding cytoplasm and other contents. She failed to explain this to her supervisors.
As an advanced biology student how would you explain to the supervisors, assuming you were
Leticia?

Item 9
During the athletics competition, Ronald S.5 student at Kingsway SS Igayaza kakumiro district experienced different physiological effects in his body such as increased breathing and heart beat . This
made him ask his friends how this could be controlled, the friend advised him to visit the nearby
hospital for healthy check up.
Task
a) As a learner of biology
i. Help Ronald understand understand the role of medulla in the control of heartbeat during the athletics (12 marks)
ii. Inform Ronald the changes that occurs to the heart rate in the circulatory system during athletics competition. (13mark)

Item 10
Mr. Isaac was exposed in the room which was filled with smoke due to complete burning of charcoal in the stove .he later became acclimatized such body weakness and difficulty in breathing. He has come to you for guidance.
Task
i. Help him to understand how the carbon dioxide was transported from its site of production to the lung were it was expelled (15 marks)
ii. Inform Mr. Isaac on how he became acclimatized in the room (10 marks)

Item 11

Joseph was preparing tea in his room as he tried to pick the saucepan he accidentally fallen down which made hot water to pour on his leg; after forty minutes he had pain , heat and swollen on that localized part. He later felt fever in entire body. On visiting the hospital the medical doctor gave him the first aid waiting for improvement in his life .

Task

i. Inform Mr. Joseph the importance of above events on his body (8 marks)

ii. Explain how phagocytes were able to reach where the tissue damage had occurred (4 marks)

iii. Help him understand main role of each phagocytes in the human immune system. 10 marks

iv. What does phagocytes means (3 marks)

Item 12

A S.5 student obtained the heart from the cow. He wondered about its nature and how it works. He checked in the Advanced biological science book and found that the heart muscles are cardiac in nature which surprised him. He continued his findings in different mammals noting his observations.

Task

i) Suppose you're the consultant: Help the student to describe the cardiac cycle of the heart during its functioning (19 marks)

i. Why did peter referred the heart as cardiac not a bone (2 marks)

ii. How does the heart regain its original shape after contraction (4 mark)

Item 13

John is a 50-year old man who recently started a routine health-up. His doctor informed him that his blood test showed elevated levels of fats and cholesterol. The doctor advised him to make a dietary and life style changes to manage his lipid profile.

(a) Based on John's lipid profile, what potential risks might he face if no changes are made?

(b) As a student who has studied chemicals of life, explain how lipids are formed in John's body.

Item 14

Kagimu a 7 year old boy was sent at the shop to buy cooking oil by the mother, on his way back home unfortunately he was knocked by a stone and he fell down. On his surprise, he recognized that the cooking oil he bought was almost finished on the ground. He decided to add water in the remaining cooking oil to avoid problems from his mother, however on his surprise he saw another layer forming between the cooking oil and water the thing that puzzled his mind.

(a) Help Kagimu to understand what was puzzling his mind according to the scenario

(b) Help Kagimu to understand the possible ways how water can dissolve and also understand the property of water exhibited.

(c) Further assist Kagimu to understand the structure of water.

Item 15

John a fisherman in Busabala was carrying out his activities very early in the morning, on his surprise he observed some birds walking on the surface of water which puzzled his mind.

He has come to you for an explanation

(a) Help John to understand what was puzzling him according to the scenario.

b) Help John to understand other physical properties of water and how they are related in biological systems.

Item 16

In their discussion, Opio told Ochaya that proteins are health giving foods and they contain amino acids which are buffers. This confused the mind of Ochoya because he could not understand the meaning of the word buffer. He has approached you for guidance.

Help Ochaya to understand the meaning of the word said

according to the scenario.
(b)Further explain to Ochaya how amino acids act as buffers (5 scores)
(c) Basing on different structures of the proteins, how are they of great value in living organisms (6 scores)

Item17
There is a debate among botanists about whether plant cells have lysosomes, as these structures are normally associated with animal cells, as some vacuoles in plant cells have hydrolytic enzymes and perform liposomal activities. Some botanists think that plant cells have lysosomes. This view is not universally accepted, as the lysosomes in plants do not carry out all the usual activities of the lysosomes found in animal cells.
a) What are the usual activities carried out by lysosomes?
b) As a student of Cleverland high school who has studied the ultrastructure of plant and animal cells, other than lysosomes what other cellular features are found in animal cells but not in plant cells.

Item 18
Microscopy, the science of using microscopes to examine small objects, has diverse applications in fields like biology, medicine and forensics and materials science, enabling the study of cells, tissues, microorganisms, and materials at a microscopic level. As a student who has studied microscopy, you have been approached by a colleague for assistance who has been presented with a forensic report with unfamiliar terms. Use the knowledge of microscopy to explain to him the unknown terms
a) Magnification and resolution
b) Gram positive and gram negative
c) Light microscope and Electron microscope.
d) Artifacts and organelles.

Item 19
During a senior five biology class, a teacher taught students that; in 1977, American microbiologist Carl Richard Woese and his co-workers discovered the third domain of life called Achaea (Kingdom-Arhaebacteria) based on distinctive 16S RNA signature sequences which had long been categorized as prokaryotic organisms. This became widely accepted as the third domain in

1990.Archaebacteria are known to be the oldest living organisms on earth. They are completely distinct from prokaryotes They can easily survive under very harsh conditions such as the bottoms of the sea the volcanic vents. However one of the students further requested for more information about their types and importance during study. With the knowledge that you have acquired about Arhaebacteria;
a) Name any two types of Arhaebacteria
b) How can the knowledge of Arhaebacteria be used to benefit society and the environment.

Item 20
Cleverland high school and Maya farmers Sacco under the parish development model entered into a partnership to grow tomatoes from a piece of land they had hired from the school, which would also later act as a demonstration garden to students. One day on a sunny day students found out that the farmers had transplanted their tomato seedlings to the main garden but to their surprise almost all the plants were weak and could not support themselves upright.
a) What physiological processes could have been affected during the seedling transplantation?
b) How would the problem be mitigated?

ITEM 21
A large mixed-animal research farm has reported a steady but puzzling decline in animal health and productivity over the past three months. There is no clear disease outbreak, yet:
Layer hens are producing fewer eggs, and some display breathing difficulties despite no signs of viral infection.
Dairy cows have drastically reduced milk yields, though their diet and general behavior remain unchanged.
Piglets on the same farm are losing weight, and several develop frequent skin lesions that take long to heal, even in clean pens.
A cross-disciplinary team of animal scientists, nutritionists, and biologists investigates. Samples from various animal organs are taken, but initial blood and pathogen tests return normal.
Upon close examination of tissue condition through routine observations and microscopy, the team notes the following:
In the respiratory tract of hens, the lining appears abnormally smooth, with minimal mucus and poor particle clearance.

The intestinal surface of cows seems flattened with fewer projections, and nutrient absorption appears inefficient.
The skin of piglets appears thin and fragile, with poor resistance to abrasion or infection.The team also learns that a new insulation material was installed in the animal houses 4 months ago to "reduce heating costs," but its chemical composition hasn't been verified. Additionally, the water supply system was redirected from a nearby industrial reservoir due to drought conditions
Task
(a) Based on the observed tissue features, infer the type of epithelial tissues likely affected in each animal group.
(b) Explain how the structural changes observed impair normal tissue function in each case
(c) Develop a hypothesis for how environmental or management factors may have led to the epithelial damage and design a multi-step plan addressing Biological recovery of damaged tissues.

Item 22
A veterinary outreach team is called to a progressive livestock farm where the manager has noticed something strange. Although animals appear to be feeding and drinking normally, many of them—especially young goats and sheep show signs of fatigue, stunted growth, and difficulty walking. The animals are less playful, avoid running, and in some cases show bowed limbs and abnormal posture.
The farm had recently adopted a modern, low-movement rearing model using concentrated feed and restricted outdoor grazing. While this has improved feed efficiency and minimized infections, it has also reduced natural movement and sunlight exposure. Physical injuries were ruled out by the veterinary team. However, simple movement assessments reveal reduced joint flexibility and brittle bones in some post-mortem samples.
Further tissue analysis reveals:
A pale, spongy internal texture in long bones.
Poor cartilage flexibility at joints.
Limited growth plate activity in developing animals.
The farm manager is unsure whether the issue is nutritional, genetic, or environmental. You are part of a biology student team asked to analyze the issue from a tissue and adaptation perspective
Task
(a) Describe the observed features (porous bones, poor cartilage, and joint

stiffness) and infer the types of connective tissues involved. Support your reasoning using structural clues.
(b)Explain how specific structural components in these tissues (cells, matrix, and arrangement) normally contribute to stability, movement, and growth. Discuss what might happen functionally when these structures are altered or underdeveloped.
(c) Identify two often-overlooked adaptations of bone and cartilage that help animals withstand physical stress. Explain how the absence or weakness of these adaptations might explain the symptoms observed on the farm.

Item 23
A school-based agricultural research project uses a controlled greenhouse to grow
spinach, beans, and maize for nutritional and commercial studies. Over the last month, students observed unusual patterns: the spinach and beans grew slowly, had
yellowing leaves, and produced significantly less biomass than expected, even though light, water, and carbon dioxide levels were kept constant. Maize plants showed better growth but with pale green leaves.
The students suspected a pathogen but lab tests ruled that out. Under the microscope, leaf cells from the affected plants revealed unusually small and pale chloroplasts, with few visible grana. Mitochondria appeared fewer in number and irregular in shape compared to control samples from healthy field-grown plants.
A new biology teacher challenged the students to think deeper: Could the problem
be rooted in the organelles themselves, particularly those responsible for energy transformation? The nutrient solution used lacked proper trace element analysis, and the greenhouse has been using recycled water with slight pH fluctuations.
You are a biology team assigned to diagnose the issue and recommend solutions,
focusing on the structure and function of chloroplasts and mitochondria.
Task
(a) Describe the structure and role of chloroplasts and mitochondria in plant nutrition and energy metabolism. How might their dysfunction affect plant growth and development?
(b)Explain at least two key structural adaptations of each organelle that enhance their efficiency in energy transformation processes.
(c) i) How can the observed symptoms help differentiate between chloroplast malfunction versus mitochondrial malfunction? What specific symptoms would suggest one over the other?

ii) Propose a detailed strategy to restore optimal function of chloroplasts and mitochondria in the affected plants. Consider both immediate corrective actions and long-term prevention strategies.

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b) How would the problem be mitigated?

ITEM 28

Ongom a S.1 student went fishing with his father and observed some insects walking on water.
This raised his curiosity and he became more attentive thus realized that he could as well see some green algae some floating on the surface of the water, while others a few millimeters below the water surface. He could not understand how what he observed was possible and how
significant it was in the life of organisms. He asked his father who also failed to explain.
You have been identified as a knowledgeable student is S.5 biology class, explain to Ongom what he observed and let him understand the significance of his observations in the life of organisms.

ITEM 29. Wabuyi one of the S.3 students in your school is very enthusiastic. He frequently visits the

library reading some books of biology. He recently discovered that most organisms prefer to store lipids, he wondered why. He looked for detailed information about this but he could not find it, because the book was not giving details. While in a verbal conversation with his friend Anguyo, he realized that lipids are diversely distributed in different parts of many organisms. To this day, he still asks himself how organisms benefit from this.
Based on the knowledge you have about lipids, explain to Wabuyi, giving him precise details to fill his knowledge gaps.

ITEM 30.

A science exhibition is to be held in a University near your school next week. Prepared materials of prokaryotic and Eukaryotic cells are to be observed by everyone using microscopes. Some of the invited guests do not have sufficient knowledge about these cells and will need guidance for them to be able to identify and distinguish between these two types of cells.
You have been chosen as one of the students to guide these guests as they observe the cells. Make a write that you will use on that day.

Item 31
In the Nakasongola District of Uganda, vast stretches of wetlands and swamps have been drained for large-scale rice farming and brick-making. This has led to declining water tables, loss of native wildlife (such as the endangered Sitatunga antelope and migratory birds), and increased soil salinity. The district environment officer organized a community dialogue on wetland conservation, but a local farmer, Kato, arrived late and only heard the closing statement: "If we destroy our wetlands, we destroy our future."
Task:

Explain to Kato the ecological and socio-economic impacts of draining wetlands in Nakasongola.

Item 34.

Due to a severe drought in a neighboring country, a large number of people fled to Uganda as refugees. The local government allocated land near a lake and a forest reserve for their settlement. Over time, the refugees cut down trees for firewood and shelter, polluted the lake with waste and plastic, and burned trash for warmth. This led to increased soil erosion, water contamination, and outbreaks of malaria and cholera.
Task:
Identify two environmental impacts and two health impacts caused by the refugee settlement in the scenario above.

Item 35.
Maria, a 35-year-old woman from Kampala, Uganda, has been a heavy alcohol consumer for 8 years. Recently, she has been suffering from liver pain, frequent fatigue, swollen legs, and memory lapses. During her last pregnancy, she gave birth prematurely at 6 months. Although the baby girl survived, she had breathing difficulties and showed signs of developmental delays.
Tasks for the Learner:
a) Explain the causes of the health challenges faced by Maria and her baby, linking them to her alcohol consumption.
b) Advise Maria on lifestyle changes and medical steps she should take to improve her health and support her baby's development.

ITEM 36
In Mbale district, farmers grow Irish potatoes (C3 plants) for both food and income. During a hot dry spell, the potato plants wilted, and many tubers failed to enlarge. Farmers applied mulch and evening irrigation, which helped plants to survive, but the tuber yield remained low. Meanwhile, maize nearby grew vigorously without irrigation.
Tasks:
(a) Explain why the potato plants produced small tubers despite irrigation and mulching. (10 marks)
(b) Explain how the features of the maize enabled it to thrive during these harsh conditions. (10 marks)

ITEM 37

In Mbarara district, farmers grow coffee (C3 plant) as a cash crop. During a particularly hot season, many coffee plants shed their leaves prematurely. To control the heat, farmers constructed shade using banana plants, which reduced wilting but resulted in fewer berries. Interestingly, wild weeds like the spider plant (C4 plant) nearby thrived well. Analysis revealed that the spider plant had thick fleshy leaves, a waxy cuticle, and stored water in leaf tissues.

Tasks:

(a) Explain why coffee plants gave few berries despite surviving under shade. (6 marks)

(b) Explain how the observed features of the spider plant enabled it to thrive under the same conditions. (10 marks)

ITEM 38

In Masaka district, tomato farmers experienced poor yields due to scorching midday heat and irregular rainfall. To address this, students suggested constructing a greenhouse covered with transparent polythene sheets to protect crops from excessive heat while conserving water however the tomatoes still produced poor yields. Meanwhile, the students carried out a laboratory investigation to study stomatal behavior in tomato leaves. They prepared epidermal peels and immersed them in different sucrose solutions. They observed that in dilute sucrose solution the stomata opened, while in concentrated sucrose solution the stomata closed. Later, while monitoring tomato growth in the greenhouse, the students recorded low rates of photosynthesis even though light intensity inside was high. This puzzled both the students and the farmers, who wondered what could be limiting the process.

Tasks:

(a) Based on the epidermal peel observations, what role does sucrose concentration play in regulating stomatal behavior?

(b) Imagine you are part of a student group advising farmers on greenhouse construction, explain the efficiency of materials discussed for successful tomato growth? (4 marks)

(c) Suggest what could have limited photosynthesis in the greenhouse despite high light intensity.

ITEM 39

In Luwero district, Senior 6 Biology students carried out an experiment to investigate the effect of carbon dioxide concentration on the rate of photosynthesis in an aquatic plant (Elodea). The plant was placed in water

under a lamp at constant light intensity and temperature. Sodium bicarbonate was added in increasing amounts to vary the CO_2 concentration. The students counted oxygen bubbles released per minute as a measure of the photosynthetic rate.

Their results were as follows:

CO_2 concentration (%) Oxygen bubbles per minute

0.01 5

0.03 15

0.05 25

0.08 25

0.10 25

After analyzing the table, some students concluded that the rate of photosynthesis stopped increasing because the plant had reached its maximum capacity. Others argued that another environmental factor must have become limiting. The teacher asked the class to carefully study the results and make reasoned conclusions.

Tasks:

(a) What general relationship between carbon dioxide concentration and rate of photosynthesis is shown by the results? (4 marks)

(b) Why did the rate of photosynthesis fail to increase beyond 0.05% CO_2 concentration, even when more was supplied? (4 marks)

(c) If the students wanted to further increase the rate of photosynthesis, which factor could they adjust in the experiment, and why? (2 marks)

ITEM 40

In Kalungu district, farmers grew tomatoes (C3) and maize (C4) in a greenhouse during a hot, dry season. Tomato leaves were monitored for stomatal behavior and photosynthetic activity. Epidermal peels showed that stomata opened in dilute sucrose solutions but closed in concentrated solutions. Students also measured photosynthesis rates using oxygen bubble production from leaf samples under varying light intensity and CO_2 concentration. They observed that oxygen release increased with light and CO_2 up to a certain point, then plateaued. Some tomato leaves appeared slightly wilted despite irrigation and high light, while maize inside the greenhouse remained healthy.

Tasks:

(a) Explain the effect of sucrose concentration on tomato stomata and its significance significance to plant during harsh conditions (5 marks)

(b) Explain the observed trend in photosynthetic rates with changing CO_2

levels? (5 marks)
(c) Suggest why some tomato leaves appeared slightly wilted despite optimal irrigation and light. (5 marks)
(d) Explain why Maize optimally maximized the prevailing conditions to thrive. (5 marks)

ITEM 41
During the final seconds of a 400 m sprint, athlete Nia feels her muscles tightening and her speed
dropping sharply.
After the race, laboratory results show that:
Blood lactate concentration has tripled compared to pre-race levels.
Muscle ATP levels remain higher than expected despite the low oxygen supply.
Her coach wonders how her cells managed to keep producing energy so quickly under these stressful conditions.
You are part of a student biology team asked to explain what might be happening inside Nia's muscle cells during this sprint.
Task
(a) Describe the metabolic pathway that could still operate effectively when oxygen is scarce, and identify the molecule that acts as its initial substrate. Infer how many ATP molecules are likely to be available per molecule of this substrate in such conditions.
(b) The lab technician notes that pyruvate levels are unusually low while lactate levels are high.
(i) Explain what this pattern suggests about how cells are handling pyruvate and why this adaptation might be necessary
(ii) Discuss how scientific knowledge of glycolysis can be applied ethically to improve performance without compromising integrity

Item 42
Two athletes Angel, who trains at sea level, and Kato, who trains in the highlands run side by side
during an international competition held in Nairobi (high altitude).
Despite breathing the same air, Angel quickly tires, while Kato maintains his pace effortlessly.
Later tests reveal that Kato's haemoglobin releases oxygen to his muscles more easily than Angel's under the same partial pressure of oxygen
Task
(a) Identify the type of curve that could explain this difference and describe what it shows

about oxygen binding and suggest which athlete's curve is shifted to the right and explain how this helps under low-oxygen conditions
(b) Predict what might happen to Angel's performance if her blood became more acidic during intense exercise and discuss whether using artificial methods to induce such a shift (like "blood doping") is a fair or ethical way to improve performance.
(c) Reflect on why a scientist must remain objective and evidence-driven when comparing physiological adaptations between individuals.

Item 43
During a school marathon, Liam suddenly feels dizzy and light-headed.
At the clinic, his ECG shows irregular spacing between the QRS complexes.
The doctor explains that the problem may not be in his heart muscle, but in the system that initiates and coordinates the heartbeat.
She also notes that stress and caffeine intake might be influencing his heart rhythm.
Task
(a) Describe the two key structures that normally start and coordinate electrical impulses in the heart and State what ensures that the atria contract before the ventricles.
(b) Using reasoning, explain why Liam's ECG pattern might show irregular intervals if one of these control points fails. Discuss how nervous or hormonal signals could further influence his heart rate during stress.
(c) (i) Suggest a physiological response the body might trigger to restore blood pressure when the heart rate drops suddenly
(ii).Liam's friends suggest using energy drinks to boost his heart rate before sports. Evaluate this idea in terms of scientific understanding and responsible health decisions and reflect on why a biologist or medic should remain honest, calm, and evidence-based when explaining heart rhythm disorders to anxious patients.

Item 44
During a routine check-up, three lab slides from different patients show clusters of epithelial cells packed with vesicles.
One slide comes from the pancreas, another from the skin, and another from the stomach lining.
Curiously, all three patients show unusual secretions one produces excess oil, one struggles

with digestion, and one has fluctuating blood sugar.
The biologist suspects that the same type of tissue behaves differently in each case
Task
(a) describe what key feature identifies a cell as glandular rather than a typical covering epithelium and explain how the mode of secretion (merocrine, apocrine, or holocrine) could account for the different secretions in the three patients.
(b) If you had to identify which slide belonged to the endocrine gland, explain which clues you would look for under the microscope and why.
(c) A scientist proposes using artificial gland implants to replace damaged secretory cells.
(i) Discuss one ethical concern and one potential benefit of this idea and reflect briefly on how a biologist should respond when data about tissue behavior contradict their initial assumptions.

Item 45
In order to increase food production in Uganda, two cereal crops A and B are to be imported into the country for farmers in different regions to plant them. The researchers have discovered that crop A grows well in areas of relatively low altitude and can withstand low amounts of carbon dioxide. However crop B is very sensitive to carbon dioxide levels and any slight decrease in carbon dioxide can lead to low productivity. The two crops are highly affected by extreme drought conditions.
Task.
a) Analyse the internal structural features of the leaves of the two crops and photosynthetic reactions that are responsible for the differences in the productivity of the two crops as observed by the researchers.
b) Explain how extreme drought reduce the photosynthetic efficiency of the two plants.
c) Which environmental conditions can be availed to each crop by the farmers to increase the crop yields?

Item 46
A drug developer is designing a drug that can used to control a pathogenic strain of bacteria that enters the human liver cell and feeds on mitochondria, ribosomes and Golgi body. The drug developed will bind in the active site of a bacterial enzyme that catalyses the formation of the bacterial cell wall from a substance called murein. First trials of the drug showed low efficacy of the

drug and this was attributed to the polar nature of the drug molecules reducing its entry into the liver and bacterial cells.
Task.
a) Explain how the activities of bacteria affects the functioning of the liver cells in the patients.
b) How will the interaction between the drug and bacterial enzymes lead to death of the bacteria
c) Explain why the nature of the drug molecules reduced their ability to penetrate cells and how this can be improved.

ITEM 47. Two patients X and Y were brought to the hospital for examination. Patient X presenting signs of weakened fragile bones, reduced skin strength and elasticity was diagnosed with reduced amount of cysteine in his collagen fibres. This was due a gene mutation that leads to substation of cysteine with alanine amino acid during collagen synthesis. Patient Y complaining of persistent body weakness and reduced heart beat rate was diagnosed with abnormal haemoglobin in his red blood cells which less soluble in the cytoplasm of the red blood cells making the cells sickle shaped. This was discovered to be caused by increased number of non-polar amino acid in the haemoglobin protein.
Task
a) Explain how the change in the amino acid composition of each patient results into the health conditions of patient
i) X
ii) Y
b) How can the health condition of patient Y be managed?

ITEM 48
In one of the investigations to determine effect of inhibitors on enzyme-controlled reaction, John
used a combination of amylase enzyme and egg solution while Simon used amylase enzyme and
starch solution. The teacher said that John's combination would not give any accurate result because amylase enzyme does not break down eggs.
Tasks
a) Help John understand why his combination could only give false results.

b) Explain how the different types of the factor under investigation affect enzyme activity and how they can be overcome if possible.

ITEM 49:
The bodies of organisms have many chemicals of life. These enable organisms survive successfully on planet earth. It has been observed that fats are a common food store in many organisms living in cold environments and desserts.
Tasks: Explain the observations in the scenario and how are fats formed in the bodies of living organisms.

Item 50.
During the doctor's presentation in the health awareness program, he mentioned that Lipids are one of the most essential molecules in the body of living organism however over consumption leads to heart diseases, high blood pressure and obesity. Due to the relevancy and
health risks attributed to lipids, learners are eager and interested to know the structure of lipids
and their respective roles in the body which were no mentioned during the speech. The learners
have conducted research however they are puzzled up and have approached you for help.
Task
a) Using your knowledge of chemicals of life, describe for the learners the structure of the mentioned molecules above (04 scores)
b) Identify any 3 properties of molecules mentioned. (03 scores)
c) Explain to the learners the relevancy of the essential molecules above in the body of living organisms. (08 scores)
d) Why are lipids referred as better energy storage compounds

Item 51
In the first lecture at university during study of pharmacology, the lecturer mentioned that bacterial cells are some of the major causes of diseases and have persisted because they exhibit
resistance to antibiotics, so there major goal is invading drugs to kill the pathogenic bacteria, he went ahead and classified bacteria basing on their structure however most students failed to

understand this since they had scanty knowledge about the structure of a bacterial cell.
Task
a) As a S.5 learner with knowledge of cell biology, help the learners to recall the structure of the cell mentioned. (05 scores)
b) Explain the roles of the above-mentioned structures to the survival of the organism. (07 scores)
c) Describe the structure of the inner most membrane structure basing on the fluid mosaic model and state any 4 roles of the plasma membrane. (08 scores)

Item 52
In the conference organized to sensitize and boost on agriculture, the presenter mentioned that
without plants, man cannot survive because plants are the major sources of food in the eco-system. Food is manufactured by the process of photosynthesis and therefore to increase food
production, photosynthesis must be boosted using genetical engineering. He further mentioned
that, this can be achieved by increasing the chloroplast count and their suitability to carry out photosynthesis however most S.4 learners never understood this since they lacked knowledge
about the structure of the chloroplast yet they are interested in knowing so that they apply the
knowledge to boost on the yields.
Task
a) The learners have approached you for help to resolve. Describe for them the structure of the photosynthetic organelle mentioned above. (06 scores)
b) Explain to the learners how the organelle is suited to its function of carrying out photosynthesis (11 scores)
c) What are the necessary conditions for the manufacture of food in plants.

Item 53
During the research carried out by S.6 learners to find out the nutritional status of babies under
7 years old, many were discovered to look malnourished with few brown hair, swollen pot belly stomach and wasted muscles which was a sign of protein deficiency. They explained that
these children lacked fibrous and globular proteins in their body whose structures are

primary,
secondary, tertiary and quaternary. S.5 learners who had no knowledge about the mentioned the structure of proteins got confused and they have approached you for help.
Task
a) Point out any 3 properties of nutrient molecules above (03 scores)
b) Explain to the learners the following structures of lacking nutrient to enable them resolve their confusion
i. Secondary structure (04 scores)
ii. Tertiary structure (03 scores)
iii. Quaternary structure. (02 scores)
c) Explain the relevancy of the deficient molecules above in the bodies of living organisms.

Item 54
A group of researchers used a mass spectrometer to determine the relative atomic mass of chlorine. In their findings, chlorine had three isotopes Cl-35 and Cl-37 and mass spectrum had three significant peaks at 70,72 and 74. The report shows that the relative atomic mass of chlorine is 35.5.
Juma a new comer in senior five science is inquisitive about this machine and the mass spectrum obtained.
Task:
Using the knowledge of chemistry, you have obtained;
(a)Explain to him:
(i) The mode of operation of the machine
(ii) Why only three peaks were observed on the mass spectrum
(iii) One other use of the machine in daily life
(b) Calculate the percentage abundance of each isotope of chlorine from the data and hence sketch the mass spectrum of chlorine.

Item 55
On analysis by senior five chemistry students on compound K, it was discovered that compound K contains 39.9% Copper, 21.3% Sulphur and the rest being Oxygen. Husina a senior four student finds this information strange and she has approached you for help about substance K.

As a chemistry student help her to understand compound with its:
(a) Empirical formula of K.
(b) Molecular formula of K provided 0.05 moles of X weighs 8.006 g.
(c) IUPAC name compound K

Item 56
While in the laboratory, an argument rose up between two senior three students after seeing certain information on one of the bottles in the laboratory. This information is for compound D which is an organic acid whose formula is: HxCyOz .
nH2O. On its bottle its written that D contains 26.7% Carbon, 2.2% hydrogen and 71.1% oxygen by mass. On the same bottle its written that it has a vapour density of 5.625X10-3gcm-3 at s.t.p.
Your of chemistry has requested to help the senior three students under the issue at hand. In your message include the following:
(a) Determine empirical formula of the anhydrous form of Q.
(b) Deduce the values of x, y and z.
(c) Determine the value of n and hence the formula of the hydrated D.
(d) Write the IUPAC name of D.
(e) Determine the percentage of water of crystallization in D.