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P530/1 D.C

BIOLOGY, PAPER 1

APRIL, 2025

85

MENGO SENIOR SCHOOL
S.5 END OF TERM I ASSESSMENT, 2025
BIOLOGY, PAPER ONE

(THEORY)

DURATION: 2 HOUR 30 MINUTES

Instructions:

- This paper consists of six items.
- Attempt all items in section A and choose one item from section B.
- Your answers must be precise, accurate, and in proper handwriting.

FOR SCORER'S USE ONLY

Item	Score	Scorer's comment
1	18	
2	18 20	
3	20	
4	12	
Section B	15	
TOTAL <u>85</u>		

b) A father
body.
tra

ITEM 1.

During the Hm's assembly at orientation, Mabike and his S.5 group were all guided never to leave school without any permission, however one day together with peer group, he escaped from the dormitory to go to attend a night club, but as they started dancing, Mabike collapsed and was rushed to the hospital. On examination, doctors detected higher percentages of Carbon dioxide gas that accumulated in the body tissues, higher Carbon monoxide gas due to the fact that he was smoking cigarette and shisha, hemoglobin (Hb) levels were low of 8g/dl, higher heart rate of 130 beats per minute, high blood pressure of 150mmHg. The doctor also went ahead to explain to them that due to accumulation of the gas, it affected the oxygen dissociation curve (O.D.C). However his father was confused and teared the doctor's report.

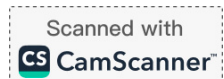
Task;

- a) As a senior five student who has just learnt about transport in humans, you have been approached by the father to solve his confusion, explain to him the cause of the collapsing of Mabike.

(04/scores)

High Carbon monoxide gas combined with Haemoglobin forming a permanent and stable complex Carboxyhaemoglobin. This reduced the amount of Haemoglobin molecules available to carry oxygen gas to the respiring tissues and the brain. This decrease in the amount of oxygen transported to the respiring tissues and the brain (insufficient oxygen supply to the brain) reduces the rate of respiration and production of ATP energy resulting into collapsing.

(04max)



b) A father went ahead to ask how the gas that led the increase in heart rate is transported in the body. Explain to him how the gas is transported in the body. (Consider the route that transports the highest percentage). (8 scores)

The Highest % of CO_2 in Blood is transported in form of Bicarbonate ions (HCO_3^- ions) from the respiring tissues to the lungs for elimination in exhaled air.

In Respiring tissues, Carbon dioxide diffuses out of the respiring cells into tissue fluid, then wall of blood capillaries, plasma membrane into the Red Blood Cell. While inside the RBC, it combines with water forming a weak carbonic acid, under catalysis of carbonic anhydrase enzyme. Carbonic acid dissociates to form Hydrogen ions (H^+ ions) and Bicarbonate ions (HCO_3^- ions). The Bicarbonate ions diffuse out of the RBC into blood plasma and are transported to the lungs. H^+ ions displace Oxygen from Oxy-haemoglobin to release Oxygen and form Haemoglobin acid. Cl^- ions diffuse into RBCs to maintain electro-neutrality. A condition called Chloride Shift.

Once in the lungs, Haemoglobin acid dissociates releasing H^+ ions. HCO_3^- ions combine again with the H^+ ions forming H_2CO_3 which dissociates forming CO_2 and H_2O under catalysis of Carbonic anhydrase. CO_2 diffuses out of the RBC through the walls of blood capillaries, walls of alveolus into alveolar space, then diffuses into the atmosphere via Bronchioles, Bronchi, Trachea, Nostrils.

c) From the doctor's report, he also emphasized that gas explained above in (b) has significant effect on the loading and unloading of oxygen in body. As the biology best student who is reading to become a doctor, explain this statement. (08 max)

(06 scores)

In Low CO_2 partial pressures, e.g. in the lungs, the Haemoglobin's affinity for O_2 is high, thus more O_2 readily combines with Haemoglobin forming ^{more} oxyhaemoglobin. Thus more loading of blood with O_2 in the lungs.

e.g. In Respiring tissues

In High CO_2 partial pressure, the Haemoglobin's affinity for O_2 is low. So less O_2 combines with Haemoglobin forming less Oxyhaemoglobin and more Oxyhaemoglobin readily dissociates in high CO_2 conditions to release sufficient O_2 to Respiring tissues. Hence more unloading of Blood with O_2 in the Respiring tissues.

ITEM 2.

(06 max)

During a recent study at Mbarara University, researchers in dermatology have discovered that glycerol-based lipids containing oleic and stearic fatty acids are one of the most effective and healthiest organic skin moisturizers, insulates the body against heat loss. The researchers also discovered that shea nut is an ideal source of those fatty acids.

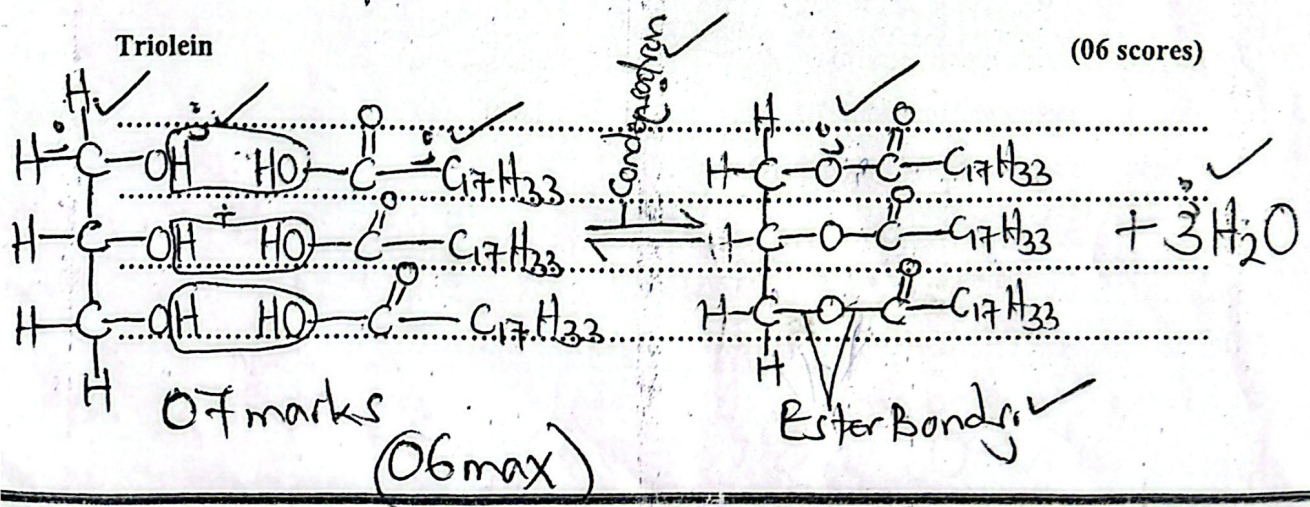
The faculty of dermatology has therefore decided to establish facilities that can be used to isolate oleic and stearic fatty acids from shea nut seeds to be used in the manufacture of skin care products. Oleic and stearic fatty acids have the formulae $\text{C}_{17}\text{H}_{33}\text{COOH}$ and $\text{C}_{17}\text{H}_{35}\text{COOH}$ respectively, which when reacted with glycerol form triolein and tristearin.

TASK:

a) i) As a S.5 learner who has knowledge about lipids, show how triolein and tristearin can be manufactured by the dermatologists to be used in making the skin care products.

Triolein

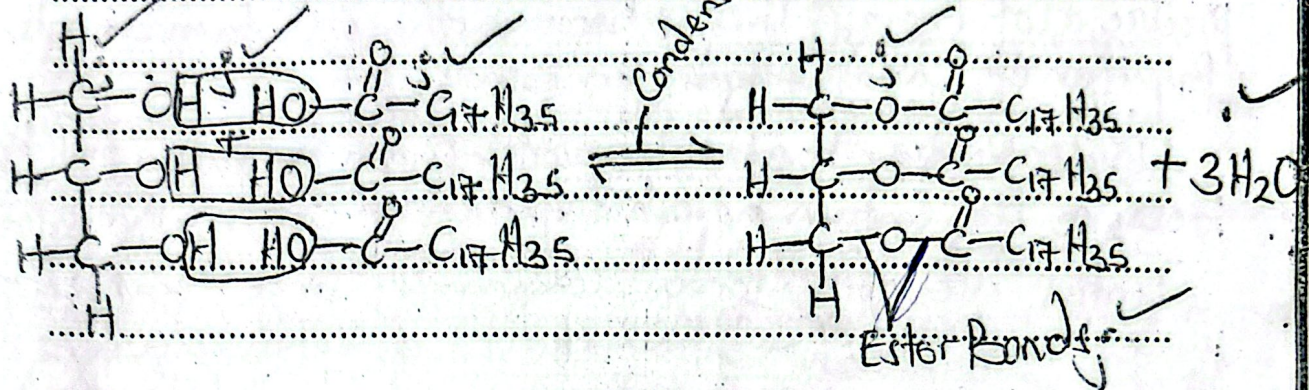
(06 scores)



- 2 H₂O groups the OH groups ✓
which gives the OH groups ✓
- Glycerol Structure Required ✓
- 3 Fatty acids (Structure not Required but Number Required) ✓
- Condensation Reaction ✓
- 3 Water molecules (Number required but not Structure) ✓
- Ester Bonds if mentioned ✓

Tristearin.

(05 scores)



(05 max)

ii) With a reason, identify the type of reaction that leads to the formation of triolein and

Tristearin.

Condensation Reaction ✓

(02 scores)

Reason: This is combination of simple molecules forming one large complex molecule with loss of 3 water molecules (2 marks)

b) Giving a reason in each case, suggest which of the two products is;

i. A liquid at room temperature.

(02 scores)

Triolein ✓

Reason: Has fewer Hydrogen atoms showing presence of double bond and so unsaturated ✓

(02 marks)

outwards into the aqueous environment

ii. A solid at room temperature.

(02 scores)

Triolein ✓

Reason: Has more Hydrogen atoms showing presence of single bonds and so saturated. ✓ (02 max)

c) Explain the physiological functions of lipids in the body of an organism. (03 scores)

Lipids have a high Calorific value, upon oxidation, lipids produce a lot of energy. This is because they contain a high proportion of Carbon-Hydrogen bonds.

Lipids produce metabolic water upon oxidation. This is because they contain a high proportion of Carbon-Hydrogen bonds.

Lipids are good storage compounds since they are highly insoluble in water so they don't diffuse away. ✓ (03 max)

ITEM 3.

During the opening S.5 practical sessions on microscopy, Joel was provided with both different part of plant tissues on already prepared slides X, Y and Z with description as shown in the table below, to observe and make deductions about tissues.

Slide X	Thin slices of Irish potato tuber stem.
Slide Y	Thin slices of midrib of commelina leaf
Slide Z	Extracted from outer thin layer of a seed coat.

Joel was amazed about how the cell structure and arrangement in these tissues.

Task;

- a) Identify these tissues X, Y and Z that were observed by Joel and his group, and the role played by each in the organisms where each is extracted. (06 scores)

Phloem - Transports manufactured food ✓

Xylem - Provides support to the plant parts ✓
- Transports water and mineral salts ✓

Tissues	Identity	Role played by the tissue in the organism.
X	Parenchyma ✓	Storage of food ✓ Provides support under turgidity ✓
Y	Collenchyma ✓ Xylem ✓ Phloem ✓	Provides mechanical strength and support to the plant parts ✓
Z	Sclerenchyma ✓	Provides support and mechanical strength to the seed coat, thus making it tough to protect the seed ✓

(16 max)

b) Describe the structure and arrangement of cells in the tissues observed on slides Y and Z

i) Structure and arrangement of Y

OR Xylem tissue (04 Scores)

Collenchyma
Living cells with little cytoplasm ✓
Cell wall composed of cellulose, pectin and hemicellulose with uneven deposition of cellulose much of it at the corners of cells ✓
Cells are polygonal in shape ✓
and elongated with tapering ends ✓
Cells are tightly packed together ✓

Compound tissue containing tracheids, vessel elements, fibres and xylem parenchyma ✓

(04 max)

ii) Structure and arrangement of Z

OR Phloem tissue

Compound tissue containing sieve tube elements, companion cells, phloem parenchyma, fibres, sclerids, tannin (04 Scores)

Cells are dead when mature, with no cytoplasm ✓
Primary cell wall is heavily thickened with thick deposits of lignin ✓
Cell walls contain pits ✓
Sclerenchyma contain fibres and sclerids ✓
Stone cells ✓

(04 max)

c) Explain how is the tissue observed on slide X adapted for its role in the organism?

(06 Scores)

- Unspecialized cells to divide and specialize into different cells or tissues performing different functions ✓
- Many inter cellular spaces for rapid diffusion of gases during gaseous exchange ✓
- Thin cellulose cell wall for rapid passage of materials ✓
- Elongated cells to serve as packaging tissue between specialized cells e.g. in phloem and xylem ✓
- Permeable cell wall to permit passage of water that cause turgidity ✓
- Cell walls contain cellulose, pectin and hemicellulose for support ✓
- Large cell vacuoles containing large quantities of cell sap to provide support by turgidity ✓

(16 max)

③ Water has a low viscosity. ✓

molecules can easily slide past each other with less friction. This allows aquatic organisms to easily swim through it with minimal resistance.

ITEM 4. During a biology ecological study trip, a group of scientists visited a lake ecosystem that had suffered pollution due to activities of the nearby town. They noted that the population of fish, and other aquatic organisms had reduced greatly over the years, some insects were walking on water and some green algae were floating. The scientists got amazed. From the water samples they collected for testing, the laboratory tests showed high contents of ions like nitrate, phosphate, sodium, calcium, aluminium among others in the medium.

Task: ④ Water has a Neutral pH, allowing a variety of flora and fauna to survive in it. ✓

Explain how medium of above ecosystem enabled it to;

i) Support aquatic life.

(06 scores)

① Water is transparent. ✓ It allows light to pass through to a certain depth. This enables photosynthetic organisms to absorb enough sunlight and carry out photosynthesis. ✓ The light penetration also improved on the visibility. Thus aquatic organisms can easily escape from their enemies, locate food, mates etc. (06 max)

② Water has a high surface tension due to strong cohesive forces of attraction that hold the water molecules together and create a strong elastic layer on the water surface that enables aquatic organisms to skate/float on water. ✓

ii) Contain high contents of ions.

(03 scores)

Water is a universal solvent. ✓ It dissolves all polar molecules and ions. ✓ If a salt like NaCl is added to water, it dissociates forming Na^+ ions and Cl^- ions. The partially positive Hydrogen atoms in water molecules surround the Cl^- ions and the partially negative Oxygen atoms in water molecules surround the Na^+ ions. Thus dissolving the salt. Hence many ions dissolved in it e.g. Na^+ ions, Cl^- ions, NO_3^- , PO_4^{3-} ions etc. ✓ (03 max)

iii) Identify the likely causes of pollution of the ecosystem as demonstrated in the scenario. (03 scores)

- ✓ Discharge of untreated sewage and wastes into the water
- ✓ Use of Inorganic fertilizers in nearby farmyards.
- ✓ Use of Pesticides in nearby farmyards to control the pest population.
- ✓ Oil spillage from nearby Garages of machines, Vehicles, Motorcycles etc.

SECTION B (15 Scores)

Answer only ONE item

Accept any other correct cause (03 max) of water pollution.

5. A group of Mengo senior school S.5 students carried out experiments to determine the action of drugs, and observed that drug M exerts its effect by binding onto intracellular organelles that affect cell activity, while drug N exerts its effect by attaching on specific receptor sites on the plasma membrane affecting its permeability to ions. The students attributed this to the chemical nature of the drugs and the fluid mosaic model of the cell membrane that makes it selectively permeable.

Task;

- a) Explain the difference in the chemical composition of drugs M and N that attribute to their difference in asserting their effects. (04 scores)
- b) Provide a write up describing the nature of the plasma membrane as described by the students. (08 scores)
- c) Give examples of natural molecules within the human body that exert their effects as;
 - i) Drug M (01 score)
 - ii) Drug N (01 score)
- d) Identify the structure on the plasma membrane that may act as receptor site for drug N. (01 score)

ITEM 6.

A group students from Nkwakyo Secondary School observed the cellular structure of two different organisms **W** and **Z** under a microscope and noted the following: Cell **W** had a rigid cell wall, a large central vacuole, and numerous chloroplasts. Cell **Z** had a flexible cell membrane, a glycogen granules, and no chloroplasts. However, they have little knowledge about the cellular structures and has approached you for help.

Task;

- a) As a biology student, identity the type of cells observed by the students and state the roles of their parts that were observed. (08 scores)
- b) Apart from the features observed by students, compare the other features of the two cells as seen under a microscope. (07 scores)

END

② ^{marks} If easily passed through the non-polar phospholipid tails with little or no resistance into the cytoplasm attached onto the intracellular enzymes that affect cell activity. Identity. — 1mk
Reason — 1mk.

Drug M — is a polar substance. ^{marks} It was unable to pass through the hydrophobic phospholipid tail in the plasma membrane.

OR

Drug M — is a small sized substance. Non-charged substance that could easily go through the small pores between the hydrophobic tails.

Drug M — is a large-sized substance or charged substance which would be repelled away by the hydrophobic phospholipid tails in plasma membrane.

(b)

The plasma membrane is mainly made up of phospholipid Bi-layer and protein molecules.

Each phospholipid molecule has a hydrophilic ~~head~~ (Polar / water loving) head made up of a phosphate group projecting outwards into the aqueous environment and 2 hydrophobic (Non-polar / water

Cell Z - Animal Cell

(2 marks)

Functions of the Parts:

For Cell W

① Cell wall.

- Mechanical strength and skeletal support is provided for individual cells and for the plant as a whole.
- Cell wall is fairly rigid and resistant to expansion and therefore allow development of turgidity when water enters by osmosis.
- Orientation of cellulose microfibrils limits and controls cell growth and shape because the cell's ability to stretch is determined by their arrangement.
- The system of interconnected cell walls is a major pathway of movement for water and dissolved salts.
- Cell walls develop a coating of waxy cutin, the cuticle, on exposed epidermal surfaces reducing water loss and risk of infection.
- The walls of xylem vessels and sieve tubes are adapted for long distance translocation of materials through the cells.

- The Cell wall, at root endodermis are impregnated with suberin that forms a barrier to water movement.

- Some Cell walls are modified as food reservoirs as in storage of Hemicelluloses in some seeds.

Q2 max) The Cell walls of transfer cells develop an increased surface area, and the consequent increase in surface area of the Cell surface membrane increases the efficiency of transfer by active transport.

② Large Cell Vacuole.

- Storage of food substances e.g. sugars some etc.

- The concentrated Cell sap causes water to enter by osmosis and the Cell becomes turgid. Turgidity brings about support in herbaceous plants and plays a role in enlargement and growth of young plant Cells.

Q2 max) Cell vacuoles of some plant Cells e.g. petals of flowers, contain coloured pigments to attract insects for pollination.

- Vacuoles in leaves accumulate waste products e.g. tannins and are removed when the leaves fall.

③ Chloroplast

It is where photosynthesis occurs.

For Cell 2

① Cell membrane

✓ Forms a protective barrier between the cell contents and external environment.

✓ It determines the shape of the cell.

✓ Forms membrane organelles e.g. mitochondria, chloroplasts etc.

✓ It is selectively permeable and regulates movement of materials in and out of the cell.

✓ Has surface protein receptors which are involved in signal transduction.

✓ Has some proteins which act as enzymes catalysing certain biochemical reactions e.g. photosynthesis.

✓ Has surface proteins involved in cell-to-cell recognition.

② Glycogen Granules

Stores carbohydrates for the animal cell in form of glycogen.

(b)
Similarities

Both have Nucleus, Cell membrane, mitochondria, Cytoplasm, Ribosomes, Golgi Bodies, ER (RER and SER)

(04 max)

Differences

Cell 1

Cell 2

Nucleus located at the periphery

Nucleus located at the centre

Lacks Centrioles

Has Centrioles

Has tonoplast

Lack tonoplast

Has Regular shape

Has an irregular shape

(03 max)

Total Item 6 = 15 Score -