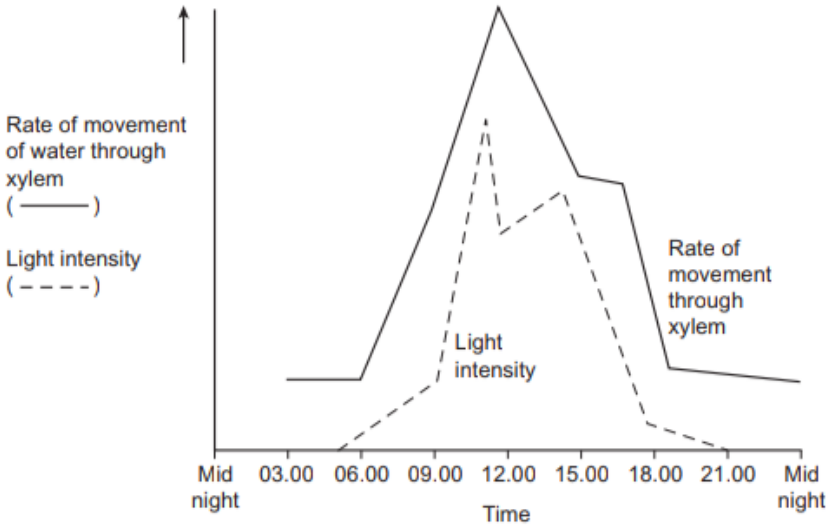
S.5 MID TERM THREE EXAMINATION
BIOLOGY (P530/2)
(THEORY)
TIME 2HOURS 30MINUTES

INSTRUCTIONS TO CANDIDATES

*Answer question **one** in section **A** plus **three** others from section **B***
Candidates are advised to read the questions carefully, organize their answers and present them precisely and logically, illustrating with well labelled diagrams where necessary.

SECTION A (40MARKS)

1. The graph in the **figure 1** shows the rates of water movement through the xylem of a twig from a tree and light intensity over a 24-hour period. Study the figure and answer the questions that follow.



(a) (i) Describe the relationship between the rate of water movement through the xylem and light intensity. (03marks)

Between 0300hrs and about 0600hrs in absence of light, rate of water movement through the xylem remains constant;
Between about 0600hrs and 1120hrs as light intensity increases; rate of water movement increases rapidly;
Between 1120hrs and 2100hrs as light intensity decreases, rate of water movement through the xylem decreases;

(ii) Explain the changes in the rate of water movement through the xylem over the 24-hour period. (07marks)

From 0300hrs to about 0600hrs, rate of water movement through the xylem is low and remains constant; because there is no light; thus stomata are closed; no transpiration occurs;
From about 0600hrs to 1120hrs, rate of water movement through the xylem increases rapidly; because increased light intensity; increases stomatal aperture; rate of transpiration increases rapidly; creating a transpiration pull; that draws water molecules through the xylem by cohesion;
From 1120hrs to 2100hrs, rate of water movement through the xylem decreases; because decreased light intensity; decreases the stomatal aperture; decreasing loss of water from the leaves by transpiration;

(b) Explain

(i) the difference in the diameter of the trunk of the tree on which the twig had been growing at 1200 and 0300hrs. (04marks)

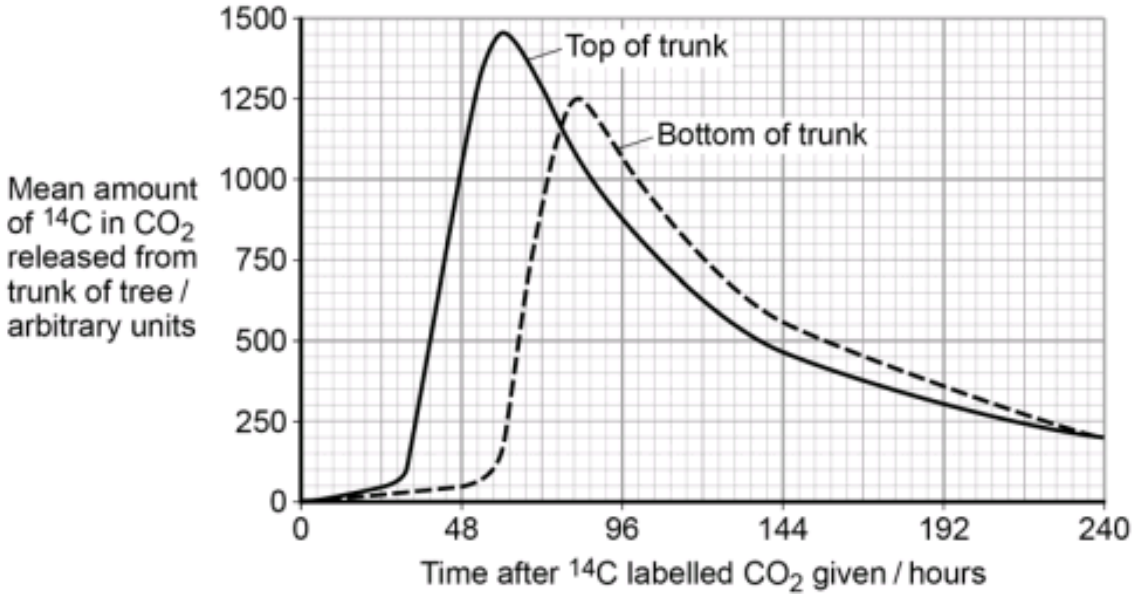
Diameter of trunk of the tree at 1200hrs is lower than at 0300hrs; because at 1200hrs, light intensity is higher than at 0300hrs; rate of transpiration is higher; tension (negative pressure) is higher in the xylem vessels; thus causing a more reduction/ shrinkage in the trunk diameter at 1200hrs than at 0300hrs;

(ii) how the xylem is adapted for movement of water up the trunk of the tree. (06marks)

Xylem vessels and tracheids consists of long cells joined end to end forming a continuous column to allow transportation of water over long distances;
End walls of xylem vessels are broken to allow uninterrupted flow of water from roots to leaves;
Lumina of vessels and tracheids are narrow increasing the capillary forces;
Cellulose cell walls impregnated with lignin which increases adhesion of water molecules of upward movement of water; and also have great tensile strength preventing the vessels and tracheids from collapsing under large tension forces set up by transpiration pull;
Xylem vessels are hollow allowing water to move freely without any obstruction;
Tracheids have tapering end walls containing cellulose lined with pits that allow water to pass from one cell to another;
Side walls of vessels and tracheids have bordered pits (perforated) allowing sideways movement of water and mineral salts;

In an investigation on translocation of radioactive carbon dioxide, a large clear plastic bag was put over the leaves and branches of each tree and added radioactive carbon dioxide. The main trunk of the tree was not in the plastic bag.

The graph in **figure 2** shows the amount of radioactive carbon released from the top and bottom of the main trunk of the tree over 240-hour period. *On the surface of the trunk of these trees, are pores for gaseous exchange.*



(c) (i) Compare the variation in the mean amount of radioactive carbon released from the top of the tree trunk and bottom of trunk. (06marks)

Similarities

In both bottom of trunk and top of trunk, mean mount of radioactive carbon released,

-**attains a peak;**

-are equal at 76.8hours;

-increases from 0hours to 62.4hours;

-decreases from 84hours to 240hours;

Differences

Mean amount of radioactive carbon released from top of trunk	Mean amount of radioactive carbon released from bottom of trunk
Higher peak is attained	**Lower peak is attained**
Peaks earlier	**Peaks later**
Higher from 0hours to 76.8hours	**Lower from 0hours to 76.8hours**
Lower from 76.8hours to 240hours	**Higher from 76.8hours to 240hours**

(ii) How long did it take the radioactive carbon to get from the top of the trunk to the bottom of the trunk? Explain your answer. (02marks)

21.6hours; (accept up to 24hours); time between peak of mean amount of radioactive carbon in carbon dioxide at top of trunk and bottom;

(d) Describe a technique which can be used to monitor the movement of radioactive carbon from the top of the trunk to the bottom of the trunk. (05marks)

Radioactive tracer technique; in which radioactive carbon incorporated in to photosynthetic products for a plant exposed to radioactive carbon dioxide as a photosynthetic substrate is detected by cutting sections of the stem; placed in contact with a photographic film; autographs made; sites of radioactivity corresponding precisely to the positions of the phloem;

(e) Explain how plant tissues for translocation are suited for this function. (07marks)

Sieve tube elements are joined end to end allowing long distance transport of manufactured food;

End walls of sieve tubes are perforated forming sieve pores allowing flow of materials from one cell to another;

Sieve tubes lack nucleus when mature, and with little peripheral cytoplasm more room is created for passage of organic materials in solution;

Numerous mitochondria in companion cells to provide large amounts of energy for active transport of materials;

Plasmodesmata allow lateral movement of materials between sieve tubes and companion cells;

Cytoplasmic strands/ protein filaments aid in cytoplasmic streaming; whose movements sweep with them materials thus transporting materials from one part of cell to another;

Sclereids and fibres have lignified walls offering extra strength to tissues preventing their collapse during translocation;

Phloem parenchyma have the ability to divide forming more phloem cells; increasing surface area for transporting of organic food materials;

SECTION B (60 MARKS)

2. (a) Describe the **induced fit** hypothesis of enzyme action. (**07marks**)

Suggests that an enzyme's active site and substrate may not necessarily have a complementary shape;✓ enzymes are flexible;✓ allowing moulding of their active sites on interaction with substrate;✓ thus upon binding to form the enzyme-substrate complex;✓ the substrate distorts the shape of the enzyme;✓ and causes the active site to assume a new catalytic configuration;✓ lowering the activation energy as the substrate becomes less stable to form the enzyme-product complex;✓ the product formed no longer binds the active sites;✓ so the enzyme-product complex splits releasing the products leaving the enzyme free;✓

(b) Explain how,

(i) temperature affects enzyme activity. (**05marks**)

Increase in temperature increases the rate of reaction;✓ due to increase in the kinetic energy of the reacting molecules;✓ resulting into frequent collisions,✓ increasing reaction rate;

Excessive high temperatures denature the enzymes;✓ changing the shape of the active sites;✓ making it difficult for the substrate to fit into the active sites lowering the rate of reaction;✓

Very low temperatures inactivate enzymes;✓lowering the reaction rate;✓

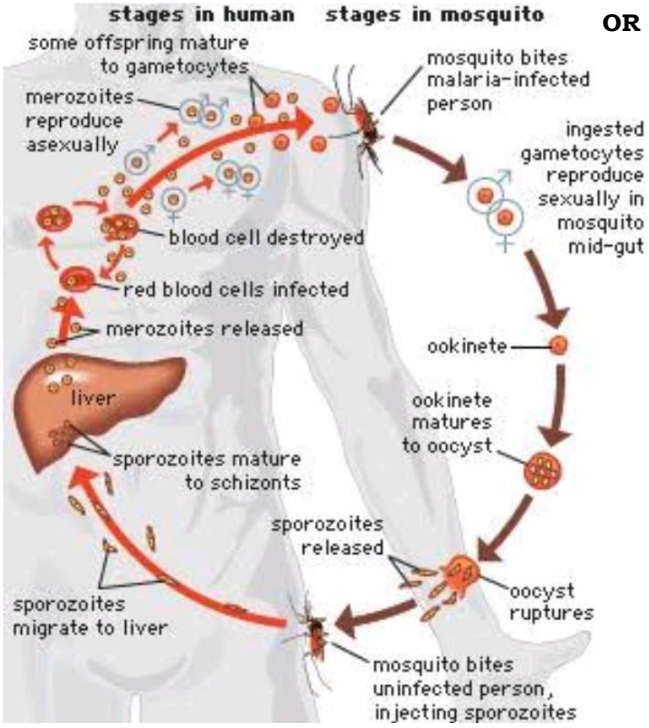
(iii) enzyme activities are controlled. (**08marks**)

Enzyme activators;✓ e.g. inorganic ions like chloride ions and magnesium ions which mould the shape of either the enzyme or substrate into a shape that allows enzyme-substrate complex to be formed;✓

Allosteric regulation;✓ during which allosteric activators; may weakly bind to the allosteric/regulatory site of an enzyme;✓ the enzyme changes shape of the active site; ✓ so as to effectively bind with the substrate;✓e.g. activation of some catalytic pathways on binding of adenosine monophosphate(AMP); allosteric inhibitors may weakly bind to allosteric/regulatory site of an enzyme; altering shape of the active site preventing the substrate molecules from binding with active site;✓ e.g. in end product inhibition, accumulation of products such as ATP inhibits one of the enzymes at the start of the reaction by attaching itself at the allosteric site, there by slowing down the rate of reaction;

Regulator enzymes;✓ such as kinase, these enzymes can transfer a phosphate group from a high energy phosphate such as ATP to an organic molecule; this phosphorylation normally required to activate the molecule;✓

3. (a) Describe the life cycle of plasmodium parasite. (**12marks**)



OR

During a blood meal by a female *Anopheles* mosquito; ✓ immature form of plasmodium parasite, sporozoite; ✓ is injected into the host's blood; ✓ transported to the liver cells where they mature into schizonts; ✓which divide forming merozoites; ✓ infecting other liver cells; ✓ Merozoites leave the liver entering the red blood cells; ✓ each dividing to form more merozoites; ✓causing red blood cells to rupture; ✓ releasing merozoites which infect new red blood cells; ✓ this causes fever; In red blood cells, some merozoites may differentiate into sexual erythrocytic stages, male and female gametotcytes; ✓ and on ingestion by mosquito during a blood meal, survive digestion in the stomach of the mosquito; ✓ transforming into female and male gametes; ✓ fertilization occurs; ✓ forming a zygote; ✓which become motile and elongated(ookinetes); ✓ penetrating the mid gut wall of the mosquito; ✓; where it develops into oocysts; ✓ grows, rupture releasing immature parasites, sporozoites; ✓ which enter the mosquito's salivary glands; ✓ Inoculation of the sporozoites into a new human host, perpetuates the parasite life cycle; ✓ @ ½ mark

(b) Outline the adaptations of plasmodium to i

Short life cycle increasing chances of reproduction in a short period of time;✓
Reproduces both sexually and asexually; increasing their number and thus chances of survival;✓
Vermiform shape/ring form; of the zygote allows it penetrate through the stomach walls of a female *Anopheles* mosquito for strategic location;✓
Acyst develops around the zygote in a female *Anopheles* mosquito which prevents it from being attacked by the immune system of the mosquito;✓
Invades both red blood cells and liver cells, increasing possible survival habitats and consequently their chances of survival;✓
Exhibits alternation of generation in which different forms differ in reproduction appearance and habits; reducing intraspecific competition;✓
Very small in size; demanding less nutrients and other life requirements for survival;✓
Uses two hosts; ensuring its survival;✓
Female *Anopheles* mosquito as a vector, spreads plasmodium parasite to its definitive host; to attain sexual maturity;✓ **@1mark**

(c) How can the spread of malaria be controlled? (**03marks**)

Introduce fish in ponds to feed on mosquito larvae;✓
Administration of preventive drugs e.g fansidar;✓
Burning of bushes around the home steads, to clear the breeding sites of the vector; ✓
Sleep under treated mosquito net; to avoid mosquito bites;✓
Spray using insecticides to kill the vector;✓
Drainage of stagnant water to clear mosquito breeding sites;✓

4. (a) Explain the role of the following in controlling heart beat rate in mammals.

(i) Blood vessels (**08marks**)

Aortic arch, carotid sinuses and vena cava consists of stretch receptors/proprioceptors;✓ in their walls;✓ connected to cardio vascular centre of the medulla of brain;✓ via sensory nerve fibres/afferent nerves;✓

Stretch receptors in walls of vena cava;✓ are stimulated by large volumes of blood returning back to heart;✓owing to contraction of skeletal muscles during intense activity;✓ increased number of impulses are transmitted to cardiac accelerator centre;✓ connected to heart via sympathetic nerves;✓ increasing the heart beat rate;✓

Stretch receptors in walls of aortic arch and carotid sinuses;✓ are stimulated by large volumes of blood pumped out of heart/stroke volume;✓ owing to a stronger contraction of muscles;✓ increased number of impulses are transmitted to cardiac inhibitory centre;✓ connected to heart via vagus nerve;✓ slowing the heart beat rate;✓ @ ½ mark

(ii) Endocrine system (**07marks**)

Consists of adrenal glands;✓ which during times of stress, excitation, and being nervous;✓ are stimulated;✓ secreting adrenaline hormone from its medulla into blood stream;✓ transported to heart stimulating Sino atrial node;✓ to increase the frequency of waves of excitation over the heart;✓ increasing heart beat rate;✓

Acc role of thyroid gland

(b) Account for the greater efficiency of double closed circulatory system over single closed circulatory system. (**05marks)**

Higher pressure of blood is boosted and maintained in double closed circulatory system than in single circulatory system;✓ more rapid flow of blood occurs;✓ faster delivery of nutrients and oxygen to respiring tissues in double circulatory system than single closed system;✓ thus a higher amount of ATP molecules are synthesized;✓ leading to higher metabolic rate;✓ and organisms become more active;✓

Higher pressure in double closed circulatory system than in single closed system;✓ allows for greater formation of tissue fluid and exchange of materials between body cells and blood;✓

END