

BIOLOGY MARKING SCHEME S01



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**DR G MBASHI EDUCATION
WORKED EXAMPLE 1
BIOLOGY 1 - MARKING SCHEME**

1. a. Features of lipids as respiratory substrates

- i. It is used only in the absence of carbohydrates.
- ii. It is not easily hydrolysed than any other respiratory substrate.
- iii. It is large molecule and insoluble in water hence difficult to transport by blood to the respiratory tissues.
- iv. It is respired only in the presence of oxygen gas hence cannot be respired anaerobically.
- v. It produces large quantity of energy and metabolic water.

Any 3 points @ 01mark – 03 marks

b. Adaptations of alveolus to its function

- i. It has large surface area for maximum diffusion of gases.
- ii. It has thin epithelium for rapid diffusion of gases.
- iii. It is moist to dissolve gases for easy diffusion in solution form.
- iv. It is highly vascularized by blood capillaries for transportation of gases.
- v. It is permeable to allow free diffusion of gases.

Any 5 points @01 mark – 05 marks

- c. At the end of the respiratory chain oxygen combine with hydrogen to form water; this enables constant removal of hydrogen atoms to prevent blocking the chain so that aerobic respiration continue.**

(02 marks)

2. a. Problems faced by taxonomists

- i. It involves many expensive research and tools.
- ii. Some organisms studied are dangerous to humans like poisonous and aggressive.
- iii. The procedures and many research activities are time consuming.
- iv. Some organisms have many mixed characteristics with different groups which make them difficult to classify like viruses.
- v. Some species of organisms are found in very difficult environment to reach by researcher.

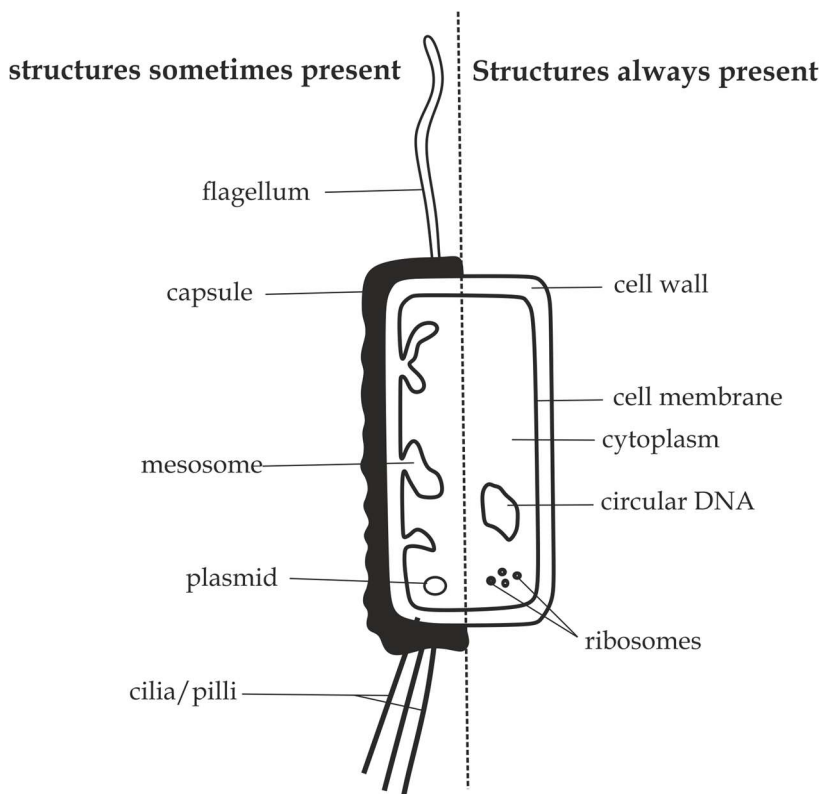
Any 4 points @ 01 mark – 04 marks

b. Procedures for construction of taxonomic keys

- i. Collect and make proper observation of organisms.
- ii. Identify the observable external features of collected organism.
- iii. Choose features which do not change with time such as wings.

- iv. Select one feature at a time and do not repeat.
- v. For each feature divide the organisms into two groups; then form two leads of organisms with and those without the features.
- vi. Arrange the leads to form a frame work of the key.

3. a. **The diagram of a prokaryotic cell**



Caption - $\frac{1}{2}$

Diagram - 02

Labels 5 parts @ $\frac{1}{2}$ - $2\frac{1}{2}$

Total - 05 marks

b. **Similarities between a prokaryotic cell and mitochondrion**

- i. Both possess smaller and fewer ribosomes.i.e. 70s type ribosomes.
- ii. Both possess small, circular and naked DNA.
- iii. Both possess many infolds in the inner membranes.
- iv. Both have fluids which bath internal organelles like cytoplasm and matrix.

Any 4 points @ $\frac{1}{2}$ mark - 02 marks

c. Differences between enzymes and catalysts

Enzymes	Catalysts
Are proteins in nature	Are simple mineral ions
Control reactions in living cells	Control reactions outside the living cells
Catalyze only specific reaction	Catalyze many reactions
More sensitive to temperature and pH changes	Less sensitive to temperature and pH changes
They can be regulated by specific molecules	They are not regulated by other substances

Any 3 points@ 01 mark – 03 marks

4. a. Features of cellulose for structural formation

- Cross linkage between the chain, to make the molecule tough, stiff and give terrible strength.
- Presence of added chemicals to cellulose like lignin and hemicellulose, to make the molecule more rigid.
- Insoluble to water, to make the molecule impermeable.

Any 2 points@ 02 marks – 04 marks

b. Classes of cofactors

- Activators;** these are inorganic ions that modify shape of enzyme to react with the substrate more easily, i.e. Cl^- , Na^+ .
- Coenzymes;** these are loosely bounded organic molecules that act as hydrogen carrier of the enzyme, i.e. NAD^+ and NADP^+ .
- Prosthetic groups;** these are tightly bounded organic molecules that increase catalytic function to the enzyme, i.e. Haem.

Class - $\frac{1}{2}$ mark

Definition - $\frac{1}{2}$ mark

Example – 01 mark

Total 06 marks

- By acting as carbondioxide pump; the malate shunt usual increase the concentration of carbondioxide in the bundle sheath cells, thus increase the efficiency with which RUBP carboxylase work. **(02 marks)**
By acting as hydrogen pump; the malate carrier's hydrogen atoms from NADP^+ in the mesophyll cell to the bundle sheath cell whereby PEP is regenerated. **(02 marks)**
 - The advantage is that NADPH_2 is regenerated by the efficient light reaction in the mesophyll chloroplast and can be used as reducing

power in the Calvin cycle of bundle sheath chloroplast whose own synthesis of NADPH₂ is limited. *(02 marks)*

- c. i. Colon;
There will be no absorption of water from undigested food.
- ii. Salivary gland;
No digestion of starch in the mouth due to the absence of salivary amylase enzyme found in saliva.
- iii. Gall bladder;
No emulsification of fats due to the absence of bile salts.
- iv. Teeth;
No mastication/ mechanical digestion of food in the mouth.

4 points @ 1 mark - 04 marks

6. a. If the size of stimulus is below the threshold level, there will be no any action potential (impulse) generated *(01mark)*.

If the size of stimulus reach threshold level or above, action potential is generated *(01 mark)*. If the size of the stimulus is very large, action potential is generated with constant size but the frequency of action potential increases. *(01 mark)*.

- b. i. **Semi – circular canals**

Responsible for dynamic equilibrium, each of the three canals possess a swollen portion, the ampulla, within which there is a flat gelatinous plate, the cupula float in the endolymph fluid. *(01 mark)*
When the head moves in any plane like upward, backward, forward or sideway, endolymph fluid in the ampulla displaces the cupula in the opposite direction to the head movement. *(01 mark)*
The sensory hair cells found at the base of the cupula detects the displacement and sends impulses to the brain through the vestibular nerve. The brain then initiates motor impulses to various muscles to correct the imbalance. *(01 mark)*

- ii. **Utriculus and sacculus**

Responsible for static equilibrium, each Utriculus and sacculus possess granules known as otoliths which are embedded in jelly like materials. *(01mark)*. When the head moves upward or upside down, otoliths displaces sensory hair cells which generates signals to the brain. *(01 mark)*. The brain interprets the body position, and instructs motor impulses to various muscles to correct the imbalance. *(01 mark)*

- c. **Advantages of refractory period**

- It separates one action potential from another.
- It ensures flow of action potential in one direction only.

2 points @ ½ mark - 01 mark

Advantage of adaptation

- It prevents damage of effectors from over stimulation.

7. a. **Causes of variations**i. **Mutation**

Mutation is a sudden and permanent changes in the genetic makeup which are then passed on from one generation to another as the result produce offspring that differ from parents.
(01 mark)

ii. **Crossing over**

The crossing over among homologous chromosomes during prophase I of meiosis resulting into new gene recombination hence variation.
(01 mark)

iii. **Independent assortment of homologous chromosomes**

Random distribution of chromosomes on the equator during metaphase I of meiosis and subsequently segregation, forming different gametes with different chromosomes which are capable of producing different offspring after fertilization.
(01 mark)

iv. **Random fertilization**

Random fertilization causes the genes from different parents to mix resulting into variation.
(01 mark)

b. **Advantages of seed reproduction**

- i. The seeds protects the embryo.
- ii. The seeds contains food for the embryo (either in cotyledon or in the endosperm).
- iii. The seed is usually adapted for dispersal.
- iv. The seed can remain dormant and survive adverse conditions.
- v. The seed is a product of sexual reproduction and therefore has the attendant of genetic variation.
- vi. The plant is independent of water for sexual reproduction and therefore better adapted for a land environment.

6 points @ ½ mark – 03 marks

- c. **Cortical reaction** is the process whereby the cortical granules from the secondary oocyte rupture and releasing lysosomes enzymes during fertilization. That is to say; it involves changes that take place in the cortical granules and the action of their lysosome enzymes; the

lysosome enzymes have two main functions which prevents multiple fertilization of the secondary oocyte. This is called a block to polyspermy. *(01 mark)*.

Firstly, they catalyse the formation of fertilizing membrane by hardening the zonapellucida. *(01 mark)*

They destroy the spermatozoa receptor sites on the zonapellucida so that the other incoming spermatozoa cannot bind to the secondary oocyte. Prior to entry of the spermatozoan, the nucleus of the secondary oocyte is stimulated and complete its meiosis II to produce ootid and second polar body. The ootid matures into an ovum and the second polar body immediately degenerate. *(01 mark)*

SECTION B

8. a. i. Endoderm
Mesoderm
Ectoderm *(03 marks)*
 - ii. **Endoderm**; forms the liver, pancreas, the lining of digestive tract as well as respiratory systems. *(01 mark)*
Mesoderm; forms bones, muscles, excretory system, circulatory system (heart, blood vessels, blood, lymphatic system) and reproductive systems. *(01 mark)*
Ectoderm; forms nervous system, epidermis of the skin and its associated structures such as hairs, nails and glands. *(01 mark)*
 - b. If no endoderm; there will be no formation of liver, pancreas, lungs and digestive tract. *(01 mark)*
If no mesoderm; there will be no formation of skeleton, muscles, gonads, excretory and circulatory system. *(01 mark)*
If no ectoderm; there will be no formation of skin, glands and nervous system. *(01 mark)*
 - c. HCG and progesterone. *(02 marks)*
 - d. **HCG hormone**:
Source: embryo
Role: Maintenance of corpus luteum to produce progesterone. *(02 marks)*

Progesterone hormone:
Source: placenta and corpus luteum
Role: Maintenance of endometrium thick and stability to prevent miscarriage. *(02 marks)*
9. a. Mass flow is the bulk transportation of materials from one point to another as a result of difference in pressure. *(01 mark)*

- b. The solution in the source was more concentrated than that in the sink. Each container had a semi-permeable membrane. **(01 mark)**
Water enters the source by osmosis which generates the hydrostatic pressure that transports solution towards the sink through the tube.

(01 mark)

The flow continued to dilute the contents of source and solutes accumulated at the sink, then the system came into equilibrium.

(01 mark)

c. Reasons for the active transportation of materials:

- i. Numerous mitochondria in the companion cells which produce ATP. **(02 marks)**
- ii. Materials are transported against the concentration gradient from the source to the sink. **(02 marks)**

d. Weaknesses for the mass flow hypothesis

- i. It is purely a physical explanation and does not explain why sieve tubes must be living and metabolically active.
- ii. It suggests that all organic substances are transported in the phloem tubes at the same speed, however, experiments show that amino acids and sugars are transported at different rates.
- iii. It does not explain about the bidirectional movement of solutes in the translocation process; because sometimes in the roots (sink) there is a high concentration of sugar than in the leaves (source).
- iv. It ignores the membrane barriers such as sieve plates as well as the factors that affect translocation such as temperature and metabolic inhibitors.
- v. It does not show the role of metabolism in phloem translocation. For example, the active mechanisms of loading sucrose to the sieve elements at the source and the unloading of sucrose from the sieve elements at the sinks are not explained.

Any 4 points @ 01 mark - 04 marks

e. Evidences for the mass flow hypothesis

- i. When phloem is cut, sap oozes out apparently by mass flow
- ii. The prolonged exudation of sucrose solution from aphid style indicates the evidence of the hydrostatic pressure in sieve tubes.
- iii. Certain viruses move in the phloem translocation stream indicating mass flow rather than diffusion since the virus is incapable of locomotion.

3 points @ 01 mark - 03 marks

10. a. Basal metabolic rate is the minimum amount of energy required to keep an organism alive during complete sleep or rest. **(01 mark)**

b. Factors which affect BMR**i. Age**

The BMR decreases with age (aging). Children have higher BMR than adults due to high rate of metabolism for growth and development. (01 mark)

ii. Sex

The BMR of females is lower than that of male. This is because; Men naturally have more muscle mass for metabolism and less fat than females regardless of the age. (01 mark)

iii. Physical activity

BMR of people involved in heavy activities is higher because they need more oxygen for metabolism such as respiration. (01 mark)

iv. Body size

Small organisms have large surface area to volume ratio for metabolism, hence large BMR than large organisms. (01 mark)

v. Body composition

A fat tissue has a lower metabolic activity than muscle tissue. As lean muscle increases, the metabolism rate increases. (01 mark)

vi. Body temperature

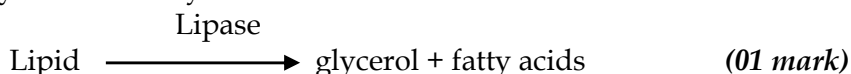
The BMR of people in tropical climate is generally up to 20 percent higher than in people living in cold climate in order to maintain constant body temperature. (01 mark)

vii. Healthy status

Fever, illness or injury may increase resting metabolic rate to 2 folds. Therefore, a sick person has higher rate of metabolism than a healthy person. (01 mark)

c. Respiratory pathways of fats or oils

Fats or oils are first hydrolysed by lipase digestive enzyme to glycerol and fatty acids.



Glycerol is phosphorylated by ATP into glycerol 3 - phosphate, then dehydrogenated with NAD into glyceraldehyde 3 - phosphate (3 - PGAL); 3 - PGAL enters the glycolytic pathway with subsequently releasing of ATP energy. (02 marks)

Fatty acids contain a long hydrocarbon chain. This is oxidized by successive removal of two - carbon fragments, in the form of acetyl coenzyme A. This process known as **β - oxidation**, occurs in the matrix of the mitochondrion. The acetyl coenzyme A is then

oxidized to carbondioxide and water by the Krebs cycle and electron transport pathway, and the coenzyme A is available for re - use.

(02 marks)

- d. i. It involves the formation of compound called citric acid(citrate) by combination of acetyl (2c) and oxaloacetate (4c). *(01 mark)*
- ii. It involves the formation of compound which possess three carboxyl groups (C00H), for example citric acid. *(01 mark)*

**DR G MBASHI EDUCATION
WORKED EXAMPLE 2
BIOLOGY 1 - MARKING SCHEME**

- i. a. i. To kill bacteria taken in with food substances. (01 mark)
ii. To produce and releasing digestive enzymes into the lumen of digestive system. (01 mark)
iii. For defence, to kill bacteria which invade the cell. (01 mark)
iv. For autolysis (self-killing of the cell), because during pregnancy number of cells in the uterus increases to accommodate growing baby, so after birth, those cells have to be destroyed in order to recover to the normal size. (01 mark)
- b. i. If meat is refrigerated, lysosomal enzymes are inactivated by the lower temperature hence preventing deterioration. (02 marks)
ii. Plants provide some ATP in the chloroplast by the process of photophosphorylation during light reaction. (02 marks)
- c. i. Glycoprotein and glycolipid. (01 mark)
ii. Phospholipids (01 mark)
- ii. a. i. There would be no standard method to be followed in assigning Scientific names. (01 mark)
ii. There would be confusion and misunderstanding in naming organisms among taxonomist. (01 mark)
iii. It would be difficult to trace evolutionary relationship that exist among organisms. (01 mark)
- b. i. Rattus rattus
Rana spp
Periplaneta americana
Taenia spp
Columbia spp (02½ marks)
- ii. **Violated rules of binomial nomenclature are:**
- In binomial nomenclature, Generic name should start with capital letter and species name followed with a small letter. In provide names above; some genus name have started with small letter and some species name have started with capital letter. For example Lumbricus Terrestris, taenia spp.
 - In typed script, scientific name should be in italic. Both in the provided names, this rule is violated because all names

are neither underlined nor written in italic. Example taenia spp, Periplaneta Americana. (04 Marks)

- iii. a. i. Pituitary gland (01 Mark)
 - ii. Follicle stimulating hormone (FSH)
 - Lutenizing hormone (LH)
 - Adrenocorticotrophic hormone (ACTH)
 - Thyroid stimulating hormone (TSH)
 - Prolactin hormone (PRL) (04 Marks)
- b. i. Progesterone hormone is used in making contraceptive pills for birth control. (02 marks)
- ii. Oxytocin is used to induce contraction of myometrium in the process of birth. (02 marks)
- iv. a. i. Because photolysis of water produces hydrogen and electrons which are used to reduce NADP to form reduced NADP which used during light independent reaction, electrons are used to replace electrons lost from PS II which were used during light reaction. (02 marks)
- ii. Bile is important for digestion because it contains bile salts that are used for emulsification of lipids hence increasing surface area for lipid digestion. It also contain mineral salts that provide optimum pH for intestinal enzymes. (02 marks)
- iii. Because if pancreas is tied, pancreatic digestive enzymes will not be delivered to the intestine hence digestion will not occur in the intestine hence indigestion, but a person will not suffer diabetes because transport of insulin does not depend on pancreatic duct because it is transported through the blood stream hence a person will not suffer from diabetes. (02 marks)
- b. **Four roles of hydrochloric acid in gastric digestion:**
 - i. Activation of pepsinogen and prorenin into pepsin and renin respectively.
 - ii. It provides best pH for gastric enzymes to work effective.
 - iii. It kills bacteria taken in with food substances.
 - iv. It hydrolyses sucrose and nucleoproteins.
 - v. It inactivates salivary amylase.

Any 4 points @ 01mark - 04 marks
- v. a. **Importance of phosphorylation of glucose during glycolysis:**
 - i. It prevents glucose molecules from diffusion out of the cell, because the charged glucose cannot easily cross the membrane.

- ii. It converts glucose molecule to more reactive form, this allow glycolysis to proceed.
- iii. It ensures that glucose is kept at a very low concentration inside the cell, so it will always diffuse down its concentration gradient from the blood into the cell.
- iv. It facilitates enzymes binding and specificity.
- v. It also cut as the starting material for the synthesis of pentose sugar and therefore nucleotides and glycogen.

5 points @01 mark - 05 marks

b. Changes occur in the breathing system when a person breath in:

- i. The external intercostal muscles between the ribs contract, this pushes the ribcage upward and outward. *(01 mark)*
- ii. The diaphragm muscles contract - this flattened the diaphragm. *(01 mark)*
- iii. The volume of chest cavity increases and pressure around the lungs decrease to less than atmospheric pressure. *(01 mark)*
- iv. The air is drawn into the lungs until pressure is balanced with atmosphere, thus **inspiration**. *(01 mark)*

6. a. i. A – Sucrase
X – Sucrose
Y – Glucose
Z – Fructose

(04 marks)

- ii. Sucrose $\xrightarrow{\text{Sucrase}}$ fructose + glucose *(02 marks)*

b. Four roles of pentoses include the following:

- i. Synthesis of nucleic acids such RNA from ribose.
- ii. Synthesis of coenzymes such as NAD⁺, NADP⁺.
- iii. Synthesis of ATP (Adenosine triphosphate) from ribose.
- iv. Synthesis of carbondioxide acceptor such as RUBP.

4 points @01 mark - 04 marks

- 1. a. The competitive inhibitors prevent substrate molecules from binding with the enzyme active site as the result reduces the rate of enzyme controlled reaction. *(02 marks)*
- b. It acts as a self – regulatory system of the metabolic pathways in the living organisms, such as respiration, growth and homeostasis. *(02½ mark)*
- c. Prosthetic groups are the type of enzyme cofactors that permanently bind to the enzymes to help catalysis such as haem in haemoglobin

while coenzymes are type of cofactor which are not remain attached to the enzymes but act as hydrogen carriers to the enzymes such as NAD^{+2} , and FAD^{+2} . (05 marks)

SECTION B

2. a. **Two factors which ensure unidirectional flow of nervous impulses:**

- i. Synapse – In synapse neurotransmitters are found in presynaptic membrane only and receptors cells are found in post synaptic membrane only, this ensures impulse can only flow in one direction from pre to post synaptic membrane. (02½ marks)
- ii. Refractory period – after the propagation of nerve impulse the axon ensures that behind the impulse the membrane rest before conduction of another impulse, thus ensures action potential can only be conducted in the region of axon which is not refractory that is in front of impulse hence unidirectional flow. (02½ marks)

b. **Effects of the following in transmission of nerve impulses:**

- a. **Axon diameter** – The larger the axoplasm diameter decreases the resistance, hence increases the conduction speed of the nervous impulses. (02½ marks)
- b. **Myelin sheath** – Myelin sheath causes the nerve impulse to jump from one node of Ranvier to another hence increases the speed of conduction in nerve impulses. (02½ marks)

c. **Significances of tactic movement in living things are:**

- i. It helps organisms to move toward the favourable condition such as euglena move toward the light for photosynthesis.
- ii. It helps organism to escape from danger and predators such as *chlamydomonas* always moves away from light of high intensity.
- iii. It helps in reproduction such as male gametes moves toward female gametes in bryophytes.

Any 2 points @ 02½ mark – 05 marks

3. a. **Effects of the following on BMR:**

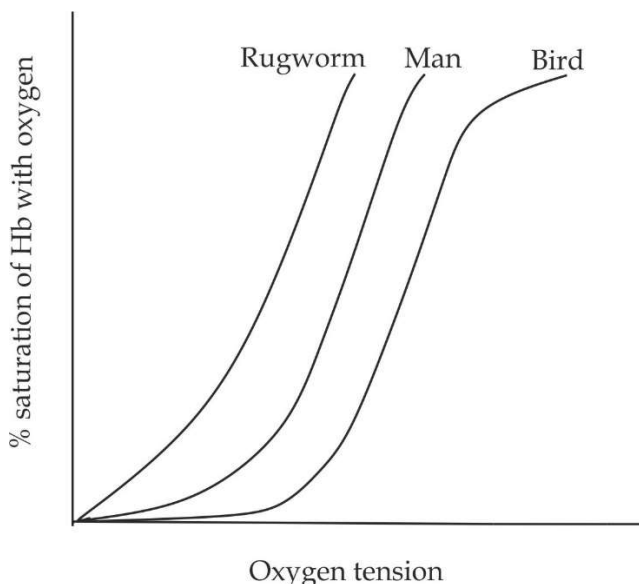
- i. **Body size** - small animals have larger surface area to volume ratio for metabolism hence larger BMR than large organisms.
- ii. **Body composition** - Fat tissues has a lower metabolic activity than muscle tissue. As lean muscle mass increases, the metabolic increases.
- iii. **Hormonal level** - Thyroxine (T_4) is the key hormone released by the thyroid glands which has a significant effect upon metabolic

rate. As T_4 level increases in the body of organism, the rate of BMR also increases.

- iv. **Health status** – Fever, illness or injury may increase resting metabolic rate. Therefore, a sick person has higher rate of metabolism than a healthy person.

4 points @ 01½ mark – 06 marks

b. Oxygen dissociation curve of Rugworm, man and bird



Interpretation:

Rugworm – Rugworm lives in burrows where oxygen tension is very low, so it has haemoglobin that has high affinity to oxygen in order to obtain oxygen gas. *(02 marks)*

Man – Man lives in environment of normal availability of oxygen in its surrounding, so it has haemoglobin with lower affinity to oxygen than rugworm, as the result the curve is shifted to the right side. *(02 marks)*

Bird – Bird is adapted for flight hence require much energy for high metabolism, to ensure this haemoglobin must readily loose its oxygen, thus haemoglobin has lower affinity to oxygen compared with man and the curve is shifted more to the right. *(02 marks)*

4. a. Nervous and hormonal control secretion of:

- i. **Saliva** – The secretion of saliva from the salivary glands is controlled by the nervous system only under two main types of reflexes, which are; conditional and unconditional reflexes. In

conditional reflexes; sight, smell, thought or presence of food in the mouth generates the impulse that is transmitted to the brain through the sensory neurone; from the brain information is sent to salivary glands through the motor neurone which causes the secretion of saliva. *(01½ mark)*

In unconditional reflex; this is due to experience of the past mainly thought of the food which stimulate the brain to send the information to the salivary glands which causes the secretion of saliva. *(01½ mark)*

- ii. **Pancreatic juice** – The secretion of pancreatic juice is controlled by nervous system and hormonal system. In nervous system; nervous reflexes induces the secretion of pancreatic juice from the pancreas through the vagus nerve. *(01½ marks)*

In hormonal system; the secretion of pancreatic juice is induced by hormones secretin and cholecystokinin (CCK). Secretin is produced in response to the acid which causes the production of mineral salts in the pancreas, whereas CCK is produced in response to partially digested fats and proteins which causes the production of pancreatic enzymes. *(01½ marks)*

- iii. **Bile juice** – The secretion of bile juice is controlled by the nervous and hormonal system. In nervous system; nervous reflexes induces the secretion of bile from the liver through the vagus nerve. *(01½ marks)*

In hormonal system; the secretion of bile is induced by hormones secretin and cholecystokinin (CKK). Secretin causes contraction of gall bladder to release bile juice into the duodenum whereas secretin stimulates the production of mineral salts from the liver to neutralize the acidic chyme from the stomach. *(01½ marks)*

b. **Plants convert light energy to chemical energy during light reaction of photosynthesis through the following process:**

- i. **Photo activation** – Photosystem I and II absorb light of suitable wavelength which causes electrons in their reaction centre to be energized hence jump to higher energy level. *(01½ marks)*

- ii. **Phosphorylation** – This is the process by which phosphate is added to ADP⁺ to form ATP under the influence of light energy from the sun, excited electrons from the PS II are taken to PS I and during the process energy is released that is used to combine Pi and ADP⁺ to form ATP, and electrons from PSI to NADP⁺. *(01½ marks)*

- iii. **Photolysis of water** – This is the process by which water is broken down to release H⁺, e and O₂, O₂ is released out as waste

product, electron (e) is used to replace electrons lost from the PSII to PS I. *(01½ marks)*

- iv. **Reduction of NADP⁺** - Is the addition of electrons and hydrogen to NADP⁺ to form NADPH + H⁺. Electrons from PS I and H⁺ from photolysis of water are added to NADP⁺ to form reduced NADP. *(01½ marks)*

**DR G MBASHI EDUCATION
WORKED EXAMPLE 3
BIOLOGY 1 - MARKING SCHEME**

1. a. **Adaptive features of frogs skin to its function as respiratory surface:**
- i. The skin is permeable to allow easy penetration of the respiratory gases.
 - ii. The skin is thin membranous to reduce the diffusion distance.
 - iii. The skin is moist for diffusion of respiratory gases in solution form.
 - iv. It is well supplied with dense network of blood capillaries for the transportation of respiratory gases.
 - v. The skin has large surface area for maximum diffusion of gases.
 - vi. Gland in the frog's skin produce mucus that keeps the skin moist and allow for respiration even on dry land.

Any 4 points @ 02 marks - total 08 marks

- b. With no oxygen available to accept hydrogen atoms released during glycolysis, an alternative acceptor pyruvate is used instead of NAD^+ which is thereby reduced and converted into ethanol or lactic acid. This switch off the passage of hydrogen atoms to the Krebs cycle and finally to the electron transport. *(02 marks)*

2. a. Amino acids exist as dipolar ions or zwitterions because:
In acidic medium (when the pH is lowered) the amino group (NH_2) Accepts hydrogen ions and the whole structure become positively charged (NH_3^+). *(02½ marks)*
While in alkaline medium (when the pH is increased) the carboxyl group (COOH) dissociates releasing hydrogen ions and the whole structure become negatively charged (COO^-). *(02½ marks)*

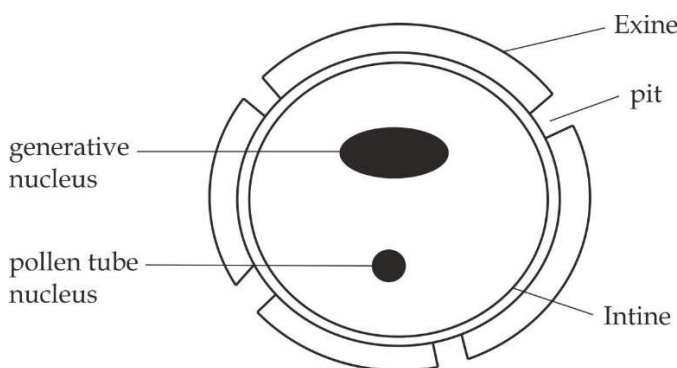
- b. **Structural modification of mitochondria:**
- i. It should possess chlorophyll for trapping sunlight.
 - ii. It should possess thylakoid for holding chlorophyll.
 - iii. The membrane should be permeable to raw materials of the photosynthesis instead of those of respiration.
 - iv. The matrix should be replaced with stroma so as to have correct enzymes for photosynthesis.
 - v. The membrane should loose cristae to provide enough space to accommodate internal membrane.

5 points @ 01 mark - total 05 marks

3. a. **Adaptations of spermatozoa to its function:**

- i. It has acrosome that released the hydrolytic enzyme for digestion membrane of the egg.
- ii. It contains nucleus which carries the genetic information.
- iii. It has mitochondria for provision of energy.
- iv. It has centrioles which initiates sperm movement.
- v. It has long tail which contains flagella for movement.
- vi. It has ability to detect chemicals secreted by the egg cell.

Any 5 points @ 01 mark - total 05 marks

b. **The diagram or structure of a pollen grain:**

Caption - 0½ mark

Correct diagram - 02 marks

Labelling - 02½ marks

4. a. **Evidences to show synapse ensures unidirectional flow of impulse:**

- i. The neurotransmitters are only released in the pre synaptic membrane.
- ii. The receptor molecules for the neurotransmitters are only found in the post synaptic membrane.
- iii. Enzymes for degrading neurotransmitters are only found in the post synaptic knob.
- iv. The mitochondria that release energy needed to resynthesize the neurotransmitters are found only at the pre synaptic knob.
- v. Calcium gate channel are only found in the pre synaptic knob.
- vi. Sodium gate channel are only found in the post synaptic knob.

Any 5 points @ 01 mark - total 05 marks

- b. i. Diverging light rays from an object reach the eye.
- ii. Cornea refracts (bends) light rays.

- iii. Circular ciliary muscles contract.
- iv. Suspensory ligaments slack/ relax.
- v. The lens becomes more convex/ thick.
- vi. Light rays become focused on the retina.

6 points @ 0½ mark – total 03 marks

- c. When looking directly at an object, light reflected from it passes along the optical axis of the eye and strikes the retina at the fovea centralis which contain cones only that can produce a detailed image in the brain only in the presence of high light intensity. At night the light intensity would be too low to activate the cones. By looking slightly to one side of the object the reflected light from it will not strike the fovea but a point on the retina to the side of it where there are rods. At night these will be activated by low light intensity and image will be produced in the brain. *(02 marks)*

- 5. a. i. There would be no emulsification of fats into fat droplets due to the reason that liver produces bile which contains bile salts such as sodium taurocholate and glycocholate which are responsible for the emulsification of lipid for easy digestion by the pancreatic Lipase.
- ii. There would be no neutralization of acidic chyme from stomach due to the reason that liver produces bile which contains mineral salts.
- iii. There would be no storage of important lipid soluble vitamins such as A, D, E and K which are obtained directly from the diet.
- iv. There will be no storage of important minerals such as iron which is produced as the result of breaking down of old red blood cells.

4 points @ 01 mark – total 04 marks

- b. **RuBP** – is a carbondioxide acceptor during carbondioxide fixation. *(01½ mark)*
NADP⁺ - Is a hydrogen acceptor during light reaction. *(01½ mark)*

- c. C₄ plants use PEP carboxylase enzyme which has the following features:
 - i. It has high affinity to carbondioxide concentration.
 - ii. It is not competitively inhibited by oxygen, thus *photorespiration* cannot occur.
 - iii. It has ability to photosynthesize even if the stomata are closed.

3 points @ 01 mark – 03 marks

6. a. Mangifera indica
Pisum sativum
Jatropha spp
Hibiscus spp

4 points @ 0½ mark – total 02 marks

- b. i. The first name of binomial that is generic name always begins with capital letter and specific name written in small letter.eg, Mangifera indica not mangifera Indica. (02 marks)
- ii. If the name are handwritten should be underlined separately, eg. Pisum sativum. (01 mark)
- iii. If several species of the same genus are ordered the abbreviation spp is used. (01 mark)

c. Importance of taxonomy hierarchy in classification:

- i. It simplifies the classification of organism by providing the best and standard method to be followed by taxonomist in assigning new scientific name to a newly discovered species.
- ii. It reveals evolutionary relationship between various organisms.
- iii. It simplifies access to information on various organisms across the taxa.
- iv. It provides smooth communication among taxonomists while avoiding confusion and repetition of species.

4 points @ 01 mark – 04 marks

7. a. i. Above 40 °C *mammalian enzymes* do not function efficiently due due to the reason that, high temperature destroy 3 dimensional structure of the enzyme causes it to stop functioning, this is called enzyme denaturation. (03 marks)
- ii. Any increase in substrate concentration will not affect the rate of the reaction due to the reason that, all enzymes active sites have bound to substrate and the remaining substrate will be unable to bind to enzyme, this point is known as saturation point.

(03 marks)

b. Cholesterol molecules

- They regulates fluidity and flexibility of the cell surface membrane. Thus prevent freezing and evaporation. At high temperature cholesterol makes the membrane less fluid while at low temperature it makes the membrane more fluid.
- They prevent ions or polar molecules from passing through the phospholipid bilayer because they are plugged in it.

2 points @ 01 mark – total 02 marks

Glycoproteins

- They act as cell recognition sites and immune respond.
- They act as cell receptors for hormones and neurotransmitters.

2 points @01 mark – total 02 marks

8. a. The mechanism of fertilization in hibiscus flower occurs by means of double fertilization; Double fertilization is the process whereby two nuclei of two male gametes in the pollen grain fuse with two different nuclei in the embryo sac, in which one of the male gamete fuses with an egg to form a zygote and the second male gamete nucleus fuses with polar nuclei to form a triploid primary endosperm nucleus.

(02 marks)

Double fertilization occurs by the following mechanism:

i. **Pollination**

Pollen grain lands on the surface of the stigma which stimulates the secretion of sugary solution (sucrose) from style tissues.

(01½ marks)

ii. **Busting of a pollen grain**

Pollen grain absorbs sucrose solution with equivalent amount of water by osmosis which creates turgor pressure inside the pollen grain hence swells, the intine then burst through exine.

(01½ marks)

iii. **Growing of a pollen tube nucleus**

Pollen tube nucleus starts to grow proceeds generative nucleus down the style under the influence of chemical secreted by the embryo sac.

(01½ marks)

iv. **Mitosis**

As the pollen tube grows toward the embryo sac, the generative nucleus behind divides mitotically to produce two haploid male gamete nuclei.

(01½ marks)

v. **Releasing of pollen grain gametes**

When the pollen tube nucleus reaches the micropyle of embryo sac, the tip of pollen tube burst and open to release the contents of pollen grains into the vicinity of embryo sac.

(01½ marks)

vi. **Double fertilization**

In the embryo sac, one sperm fertilizes an egg cell to produce a zygote (2n) and the second sperm fertilizes polar nuclei (2n) to produce an endosperm nucleus (3n).

(01½ marks)

b. Differences between menstrual cycle and oestrous cycle:

Menstrual cycle	Oestrous cycle
It is a period of uterine changes from one menstruation to the next	It is a period/ time taken for the development of the follicle cells to release eggs
It usual begins at puberty and stop at menopause	It usual begins at puberty and continues throughout the life
It occurs in primate mammals only such as human beings and monkeys	It usual occurs in non-primate mammals such as cows, dogs, horses,etc.
It occurs in both the uterus and ovaries	It occurs in the ovaries only
It is usual accompanied with discomfort	No discomfort period
Female does not permit/ allow copulation during menstrual phase of the cycle	Female permits copulation only during oestrous phase
Females can be sexually active any time in their cycle	Females are only sexually active during the oestrous period

Any 6 points @ 0½ mark – total 03 marks

c. The significances of oestrous cycle:

- i. It prepares the female body to receive the male.
- ii. It ensures that the released oocyte is fertilized as ovulation is accompanied with rising in sexual urge.

2 points @ 0½ mark – total 01 mark

9. a. i. Adaptations of phloem tissues:

- The sieve elements are joined end to end to ensure the flow of food in a continuous column.
- The sieve elements have sieve plates to prevent back flow of food.
- The sieve elements have sieve pores that allow the passage of food from cell to cell.
- The sieve elements have sieve proteins which replace the worn out cells.
- Presence of companion cells with large number of mitochondria to produce energy needed for active transport of food.

- Presence of phloem fibres to provide mechanical strength and support to the phloem.

Any 4 points @ 01 mark – total 04 marks

ii. **Roles of casparian strips:**

- They increase the chance of water moving into the xylem
- They maintain root pressure.
- They regulate the amount of water and mineral salts from soil to the xylem, since they cause active secretion of ions and salts into the xylem.
- They provide mechanical strength and support to the plant.
- They prevent the entry of toxic chemicals and pathogens into the xylem.

Any 4 points @ 0½ mark – total 02 marks

b. i. **Changes that occurs in the foetal circulation at birth:**

- As soon as the baby is born, pressure in the pulmonary artery is reduced and blood flows to the pulmonary capillaries, this causes the sudden inflation of first breath into the lungs at birth and lungs start to function. *(02 marks)*
- In few hours after birth, the concentration of oxygen in the blood increase which causes the ductus arteriosus and ductus venosus to close off whereby allowing hepatic portal vein to function and hence the liver to function. *(02 marks)*
- Tying of umbilical cord prevents the flow of blood to the placenta thus causes sudden increase in the blood pressure in the aorta, left atrium and ventricle; result into closure of the foramen ovale in few days after birth. *(02 marks)*

- ii. The absence of nucleus implies that the red blood cells are not capable of repairing themselves due to loss of genetic materials which control the repairing of the cell. *(01 mark)*

Advantages:

- Loss of nucleus and mitochondria provide a large surface area to volume ratio to enable oxygen and carbondioxide to diffuse rapidly to and from the haemoglobin.
- To provide enough room for haemoglobin.
- Loss of mitochondria prevents the utilization of the oxygen under transportation.

Any 2 points @01 mark – total 02 marks

10. a. i. The first enzyme in glycolysis is called hexokinase, the main role

of the hexokinase in glycolysis is to catalyse the phosphorylation of glucose; if this enzyme is irreversibly inhibited, there would be no activation of the sugar and the glucose would be less reactive hence the process of glycolysis would cease. (02 marks)

ii. **Roles of ATP in glycolysis:**

- It prevents glucose molecules from diffusion out of the cell, because the charged glucose cannot easily cross the membrane.
- It converts glucose molecule to more reactive form, this allow glycolysis to proceed.
- It ensures that glucose is kept at a very low concentration inside the cell, so it will always diffuse down its concentration gradient from the blood into the cell.
- It facilitates enzymes binding and specificity.
- It also act as the starting material for the synthesis of pentose sugar and therefore nucleotides and glycogen.

Any 4 points @ 0½ mark – total 02 marks

b. i. **The respiratory pathway when using lipids as substrate:**

Fats or oils are first hydrolysed by lipase digestive enzyme to glycerol and fatty acids.



Glycerol is phosphorylated by ATP into glycerol 3 – phosphate, then dehydrogenated with NAD into glyceraldehyde 3 – phosphate (3 – PGAL); 3 – PGAL enters the glycolytic pathway with subsequently releasing of ATP energy. (02 marks)

Fatty acids contain a long hydrocarbon chain. This is oxidized by successive removal of two – carbon fragments, in the form of acetyl coenzyme A. This process known as **β – oxidation**, occurs in the matrix of the mitochondrion. The acetyl coenzyme A is then oxidized to carbondioxide and water by the Krebs cycle and electron transport pathway, and the coenzyme A is available for re – use. (02 marks)

ii. **Adaptations of seal and dolphin to oxygen uptakes:**

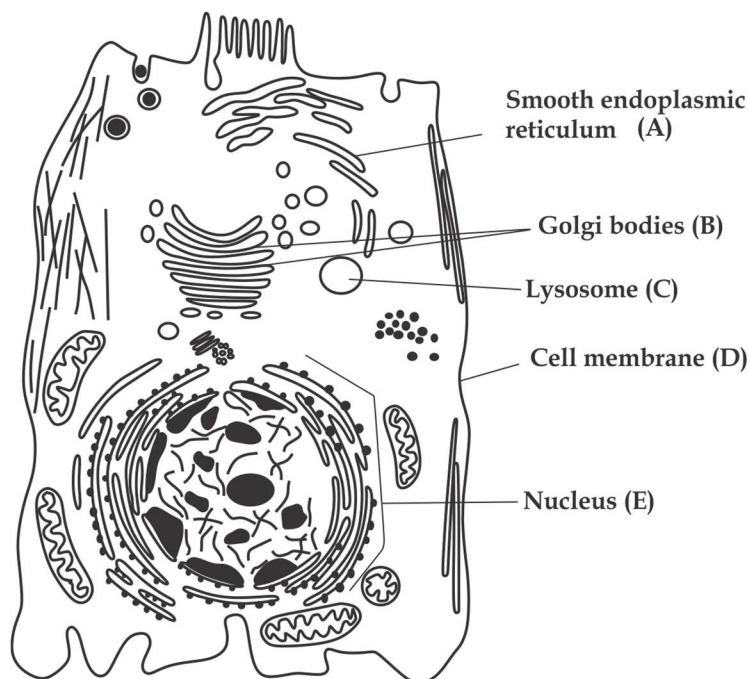
- They have a high blood volume with plenty haemoglobin. Thus allow long oxygen retention time.

- They have develop large amount of myoglobin, almost ten times, this give them a chance of blood flow of storing oxygen for a long time when under water.
- Most of blood flows to the vital organs only such as brain to reduce oxygen consumption
- Their bone marrow produces more red blood cells in order to raise the oxygen carrying capacity of the blood
- They develop slow heart rate to reduce oxygen consumption .For instance, seals reduce their heart beats from 150 to 10 beats minute.
- They have tissues tolerant to lactic acid and carbondioxide that is their muscles can work anaerobically while holding their breath.
- They can hold their breath for about two hours to reduce oxygen consumption.

Any 5 points @ 01 mark – total 05 marks

**DR G MBASHI EDUCATION
WORKED EXAMPLE 4
BIOLOGY 1 - MARKING SCHEME**

1. a. Generalized structure of animal cell under electron microscope



Correct diagram - 01½ marks

Title - 01 mark

5 labelling @0½ mark -02½ marks

Total - 05 marks

- b. **Cell differentiation** is the process through which the cells undergo structural or chemical changes and become specialized in performing different functions in the body. *(01 mark)*
 Examples of cell differentiation that modifies cells to suit their roles more efficiently include:
- i. Spermatozoa are well packed with numerous mitochondria and flagella to facilitate fertilization of ova.
 - ii. Egg cells have numerous microvilli for absorption of food from the follicular cells; they also have food reserves which nourish the developing embryo.

- iii. Nerve cells have myelin sheath and node of Ranvier which facilitate the transmittion of nerve impulse.
- iv. Red blood cells (RBCs) lack nuclei at maturity for maximum transportation of respiratory gases.
- v. Xylem cells and tracheid's cells are hollow and have lignified walls for conduction of water and dissolved minerals.

Any 4 points @01 mark – total 04 marks

2. a. **Functions of large intestine:**

- i. Reabsorption of water from undigested food materials.
- ii. Temporary storage of faeces prior to egestion.
- iii. Absorption of vitamins such as vitamin K and biotin (vitamin B) made by bacteria that normally live in large intestine.
- iv. Reducing acidity by producing bicarbonate produced by mucosa wall of the large intestine which neutralizes the increased acidity resulting from the formation of fatty acids and glycerol.
- v. Producing antibodies which is influence by several lymphatic tissues found in the appendix, the produced antibodies fight against the normal commercial bacteria and also active against relative harmful bacteria thus prevent infection.

Any 3 points @01 mark – 03 marks

b. **Fates of the end products of digestion of lipids:**

In small intestine fatty acids and glycerol diffuses into the columnar epithelial cells of the villi, where they are reconverted into lipids, then proteins present in the epithelial cells coat the lipid molecules to form lipoprotein molecules called chylomicrons which pass out of the epithelial cells by exocytosis and into lymphatic vessel in the villi. *(01½ mark)*

The chylomicrons are carried by lymphatic system to veins near the heart where they enter the blood plasma whereby the enzymes in the plasma hydrolyses the lipids back to fatty acids and glycerol again in which they are taken by the cells to be used in respiration or stored as fat in the liver, muscles or below the skin. *(01½ marks)*

c. **Fates of PGAL after it has been made in Calvin cycle:**

- i. Majority of the PGAL are used to regenerate RuBP for further fixation of carbondioxide gas.
- ii. Some of the PGAL molecules are condensed into hexose sugar and also disaccharides such as sucrose and polysaccharides such as starch.

- iii. Some of the PGAL are enzymatically converted into fatty acid molecules and glycerol hence lipids.
- iv. Some of the PGAL molecules in addition to nitrogen enter the series of events and converted into proteins.

Any 4 points @01 mark – total 04 marks

3. a. **Importance of latin language in scientific naming of organisms**

- i. It is acceptable by all scientists all over the world.
- ii. It is not changing as it is dead language.
- iii. It is a root language and many other languages have their root in it.
- iv. It is one of the oldest European languages where much of the today's scientists originated.
- v. It avoids confusion among scientists, since different organisms have different common names.

5 points @01 mark – 05 marks

b. i. Genus: Funaria

Species: hygrometrica (02 mark)

ii. **3 Rules of nomenclature used to construct above name:**

- The scientific name should have generic and specific name.
- The generic name should start with capital letter followed by specific name with a small letter.
- The scientific name if hand written should be underlined separately or italics when typed.

3 points @01 mark – total 03 marks

4. a. i. This is because lipids have a higher proportional of hydrogen and an almost insignificant proportion of oxygen compared with carbohydrates.
- ii. Carbohydrates are more readily digested than lipids and releases their energy more rapidly and also are simple to be transported to the respiratory tissues.
- iii. Cigarette smoking brought the irritation of trachea (wind pipe) and larynx (voice box) hence reduce lung function and lead to breathlessness due to swelling , excessive mucus production and narrowing of the lung airways.
- iv. Since in plants the carbondioxide which is in excess as waste product of respiration can be used as raw materials for the process of photosynthesis hence cannot affect the plant.

4 points @ 01 mark – total 04 marks

- b. i. Oxygen is a final hydrogen acceptor in the respiratory chain. (01 mark)
- ii. Stomata pores, lenticels and cuticles. (03 marks)
- iii. The exchange of gases will take place at very rate as fast moving gaseous molecules do not across the alveoli membrane more effectively, also gaseous exchange can stop completely since gases diffuse in solution form hence require moist surface to dissolve in it. (01 mark)
- iv. Whole body respiration means breathing which is inhalation and exhalation while cellular respiration refers to the processes that extract energy from bonds of nutrients molecules in the presence or absence of oxygen. (01 mark)
5. a. Functions of hexoses. e.g., glucose, fructose and galactose
- i. They are main source of energy when oxidized in respiration.
- ii. They are used to synthesize disaccharides.
- iii. They are used to synthesize polysaccharides.
- 3 points @ 01 mark – total 03 marks*
- Functions of pentoses.e.g, ribose and deoxyribose
- i. They are used to synthesize nucleic acids such as RNA.
- ii. They are used to synthesize coenzymes such as NADP.
- iii. They are used to synthesize ATP.
- iv. They are used to synthesize CO₂ acceptor such as RUBP.
- Any 3 points @ 01 mark – total 03 marks*
- b. **Factors which distort three dimensional shape of proteins**
- i. **Strong acids**
- These compounds disrupt the ionic bonds resulting into the coagulation of protein, if such protein remains mixed with these reagents for a long time, peptide bonds may also break down. (01 mark)
- ii. **Urea formation**
- Urea tends to disrupt the hydrogen bonds, being amide – like, it forms hydrogen bonds of its own via distorting the unique configuration of the protein molecule. (01 mark)
- iii. **Mechanical forces**
- Physical movement of protein may break hydrogen bonds, for example stretching of hair breaks the hydrogen bonds in the keratin as the basis of hair styling. (01 mark)
- iv. **Heat and radiations**
- These supply kinetic energy which causes atoms of proteins to vibrate more thus breaking the hydrogen and ionic bonds, For

example coagulation of egg albumin makes the white more fibrous and less soluble. (01 mark)

6. a. i. **Three events of nuclear fusion in the embryo sac:**
- Fusion of two polar nuclei forming a diploid nuclei.
 - Fusion of one male gamete and a female gamete forming a zygote.
 - Fusion of the second male gamete and the diploid nuclei forming a triploid nucleus called endosperm nucleus.

3 points @01 mark – total 03 marks

- ii. **3 events that occur in the pollen grain prior to fertilization**
- Degeneration of the pollen tube nucleus.
 - Busting of the tip of the pollen tube releasing the contents of the pollen grain into the embryo sac.
 - Generative nucleus divides mitotically to produce two male gametes.

3 points @01 mark – total 03 marks

b. **Placenta serve as a link:**

The placenta serve as a link by allowing the exchange of materials between the mother and foetus as follows:

- Passage of oxygen and nutrients from the mother to the fetus.
- Passage of carbondioxide and other wastes from the fetus to the mother.
- Passage of antibodies from the mother to the fetus.

Any 2 points @ 01 mark – total 02 marks

Placenta functions as a barrier:

The placenta functions as a barrier by preventing some materials to Enter the body of the fetus from maternal body as follows:

- Preventing blood mixing between the mother and fetus.
- Preventing the passage of pathogens such as bacteria.
- Preventing high maternal blood pressure that affecting fetus.
- Filter out hormones and chemicals.

Any 2 points @01 mark – total 02 marks

7. a. i. If the outflux of K^+ from the axon is balanced with the influx of Na^+ into the axon there would be very slight change in potential differences which is insufficient to reach the threshold required to produce an action potential. (01 mark)

- ii. The sudden influx of Na^+ into the axon following an increase in permeability in Na^+ is caused by two reasons:
- A steep concentration gradient difference of Na^+ that exists between the outside and inside of the axon which causes rapidly diffusion of Na^+ down the concentration gradient.
 - The relatively high negative potential within the axon that encourage the inward movement of the positively charged Na^+ .

2 points @ 01½ marks – total 03 marks

b. Differences between sympathetic NS and parasympathetic NS

Feature	Sympathetic NS	Parasympathetic NS
Area of influence	Effect diffuse	Effect localized
Transmitter substance	Noradrenaline	Acetylcholine
Origin of neurons	Emerge from cranial, thoracic and lumbar	Emerge from cranial and sacral region
Overall effects	Excitatory effect	Inhibitory effect
A Condition when active	Control stress	Control resting
The Position of the ganglion	Close to the spinal	Close to the effector

12 points @0½ mark – total 06 marks

8. The events and hormonal control of menstrual cycle

Menstrual cycle is a period of uterine changes between one menstruations to another. This cycle occurs in human beings and other primate mammals such as monkey, chimpanzees. Gorilla and apes. In human beings this as a 28 – day cycle controlled by hormones secreted by the pituitary gland and ovary. The function of the menstrual cycle is to stimulate the development of an egg cell in the ovary and prepare the uterus for implantation and feeding a zygote. *(02 marks)*

Events of menstrual cycle

The menstrual cycle involves a synchronised recurring sequence of changes in the ovaries (the **ovarian cycle**) linked to a sequence of changes in the lining of the endometrium lining of the uterus of the non-pregnant female (the **uterine cycle**). *(01 mark)*

a. **Ovarian cycle**

It is a sequence of changes in the ovaries during the menstrual cycle. The ovarian cycle involves three phases, which are follicular, ovulation and luteal phase. It is controlled by the pituitary hormones which are follicle stimulating hormone (FSH) and lutenizing hormone (LH). *(01 mark)*

The follicular phase

This is the first phase of ovarian cycle which involves the development and maturation of ovarian follicles in the ovary. It begins on the 1st day of menstruation until the 13rd day; it is usual characterized by the following events: *(0½ mark)*

- i. Releasing of FSH from the anterior pituitary gland. *(0½ mark)*
- ii. The development and maturation of the ovarian follicles into mature graafian follicles. *(0½ mark)*
- iii. Secretion of oestrogen from the follicle cells which has two main effects on the menstrual cycle. **Firstly**, it promotes the growth of the endometrium lining of the uterus, causing it to increase in thickness by about 0.5mm. **Secondly**, it inhibits the further secretion of FSH by the pituitary whist stimulating the pituitary to release LH. *(01 mark)*

Ovulation

This is the second phase of the ovarian cycle which involves the releasing of secondary oocyte (egg cell) from the mature graafian follicles. It begins at around day 14; it is characterized by the following events: *(0½ mark)*

- i. Releasing of LH from the anterior pituitary gland. *(0½ mark)*
- ii. Releasing of secondary oocyte from the Graafian follicle. The process is called **ovulation**. *(0½ mark)*

The luteal phase

This is the third phase of ovarian cycle which involves the formation and degeneration of corpus luteum. It begins on the 15th day until 28th day; it is characterized by the following events: *(01 mark)*

- i. The development of follicle cells which remain in the ovary to form a corpus luteum. *(0½mark)*
- ii. The corpus luteum secretes small amount of oestrogen and large quantities of progesterone. These hormones work synergistically to perform two main effects on the menstrual cycle. Firstly, they inhibit further release of FSH and LH by

the anterior pituitary, so that no further follicles develop. **Secondly**, they stimulate the further growth of the endometrium and its blood supply, so that it eventually reaches a thickness of about 5mm. This is very important to prepare endometrium for implantation. (01 marks)

- iii. If pregnancy (fertilization) does not occur, in the day 28, the corpus luteum disintegrate and degenerate as a scar called corpus luteum. As it degenerates, the corpus luteum stops secreting oestrogen and progesterone. (0½ mark)

b. **Uterine cycle**

It is a sequence of changes in the endometrium lining of the uterus during menstrual cycle. The uterine cycle has three main phases which are menstruation, proliferative and secretory phase. It is controlled by the ovarian hormones which are oestrogen and progesterone. (02 marks)

Menstruation

This is the first phase of uterine cycle which is characterized by the decline in the progesterone and oestrogen level in the blood stream causing the shedding of endometrium lining of the uterus and blood tissues through the vagina during menstruation period is called a menstrual flow. The discharged substance during this period is normally as collectively called **menses** and normally takes 3 to 5 day. (02 marks)

Proliferative phase

This is the second phase of the uterine cycle that normally corresponds to the follicular phase of the ovarian cycle. It occurs during 6th to 13th day and it is characterized by an increased production of oestrogen by the ovarian follicles which has two roles. **Firstly**, it stimulates the growth and proliferation of endometrium lining of the uterus. **Secondly**, it stimulates the crypts in the cervix to produce fertile cervical mucus. This prepare the uterus for ovulation that occurs in the 14th day of a normal cycle. (02 marks)

Secretory phase

It is the final phase of the uterine cycle that corresponds to the luteal phase of the ovarian cycle. It occurs during 15th to 28th day, it is normally characterized by an increased production of progesterone by the corpus luteum which has three roles. **Firstly**,

it stimulates the growth of the endometrium lining of the uterus in reparation for implantation of the blastocyst, and hence, supportive to the early pregnancy. **Secondly**, it stimulates the secretion of mucus from peritubular glands. **Lastly**, it increases blood flow into the uterine walls and reduces the contraction capacity of the smooth muscles in the uterus. (03 marks)

9. a. **The components of double circulation:**

Pulmonary circulation

Pulmonary circulation is the flow of the blood between the lungs and the heart. In this route; a pulmonary artery carries deoxygenated blood from the right ventricle to the lungs. The oxygenated blood from the lungs to the heart is conveyed to the left atrium by a pulmonary vein. (01 mark)

Systemic circulation

Systemic circulation is the flow of blood between the heart and all other parts of the body except the lungs. In this case, oxygenated blood leaves the left ventricle to various parts of the body through the aorta. The vena cava returns the deoxygenated blood from various parts of the body to the heart. (01 mark)

Coronary circulation

Coronary circulation is the circulation of blood within the heart chambers. The oxygenated blood enters the muscles through the coronary arteries and the deoxygenated blood is brought back to the heart chambers by coronary veins. (01 mark)

b. **The components of fetal blood circulation:**

There are five (5) main features which present on foetal circulation system:

Presence of umbilical vein

Umbilical vein is a blood vessel in the umbilical cord which connects placenta to the foetal ductus venosus. It performs the following functions:

- i. It carries oxygenated blood from the placenta to the foetus.
- ii. It carries nutrients from the placenta to the foetus.
- iii. It carries antibodies from the placenta to the foetus. (01 mark)

Presence of umbilical arteries

Umbilical arteries are blood vessels which connect the foetal aorta to the placenta. It performs the following functions:

- i. It carries the deoxygenated blood from the foetus to the placenta.
- ii. It carries metabolic waste products such as urea from the foetus to the placenta. *(01 mark)*

Presence of foramen ovale

Foramen ovale is the opening in the heart which allows the passage of blood from the right atrium to the left atrium. It prevents the flow of blood to the foetal lungs. *(01 mark)*

Presence of ductus arteriosus

Ductus arteriosus is the short blood vessel which connects the pulmonary artery to the aorta. It prevents the flow of blood to the foetal. *(01 mark)*

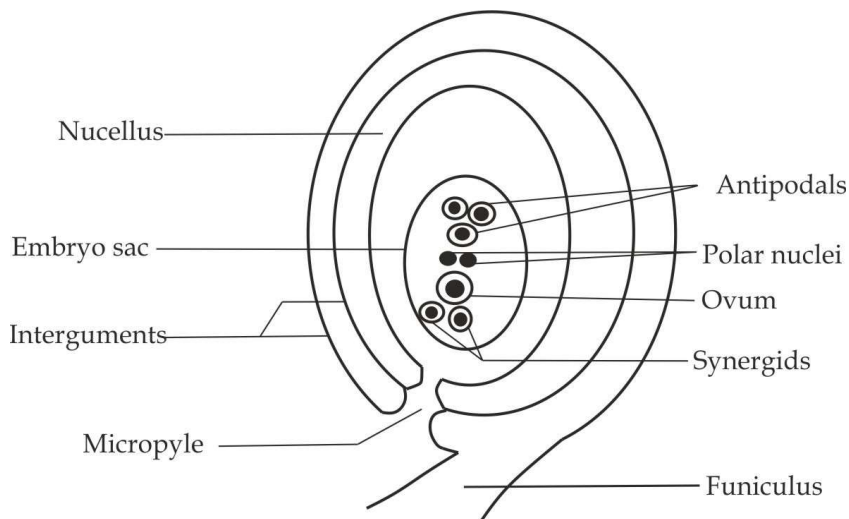
Presence of ductus venosus

Ductus venosus is the short blood vessel which connects the umbilical vein to the inferior vena cava. It prevents the flow of blood to the foetal liver. This is because the liver has no much vital function as they are being performed by the placenta. *(01 mark)*

c. The differences between foetal and adult blood circulation

Foetal circulation	Adult circulation
Blood is oxygenated at the placenta	Blood is oxygenated at the lungs
The oxygenated blood from the placenta is carried by umbilical vein	Oxygenated blood from lungs is carried by pulmonary vein
Both oxygenated blood and deoxygenated blood mix into the heart	Both oxygenated blood and deoxygenated blood can never mix into the heart
Right and left atria are connected by foramen ovale	Right and left atria are separated by septum
Blood bypasses the liver and the gut through the ductus venosus	Blood pass through the liver and gut by blood vessel called hepatic artery
Blood flows under very low pressure	Blood flows under very high pressure
Inferior vena cava exists and carries oxygenated blood	Inferior vena cava exist and carries deoxygenated blood

Any 6 points @ 01 mark - total 06 marks

10. a. **Diagram of Unfertilized ovule of the flowering plant**

Correct diagram - 02 marks

- i. **Funicle** - is a stalk that attaches an ovule to the ovary of the flowering plant.
- ii. **Micropyle** -An opening that allow pollen grain gametes to fertilize the plant.
- iii. **Nucellus** - is a parenchymatous cells in an ovule that provides nutrients for the growth of the embryo sac.
- iv. **Integuments** -These are protective layers surrounded the ovule.
- v. **Embryo sac** - Egg – cells producing chamber.
- vi. **Ovule** - A female reproductive cell that fuses with a male gamete during fertilization to produce an embryo.
- vii. **Polar nuclei** - These are two haploid nuclei that fuse with a male gamete during fertilization to produce an endosperm.

7 points @01 mark - 07 marks

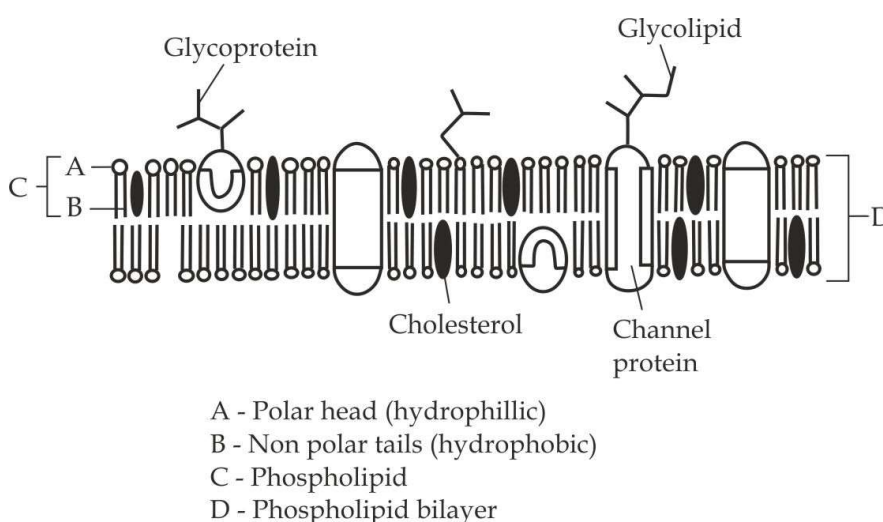
- b. Spermatogenesis is usual controlled by both the hypothalamus and anterior pituitary gland working together. The hypothalamus secretes **gonadotropin - releasing hormone (GnRH)** which travels in small veins to the pituitary gland. This hormone stimulates the anterior pituitary gland to secrete two hormones called **gonadotrophins** that stimulates gonads. In this case, the testes. The gonadotrophins hormones are **follicle stimulating hormone (FSH)**

and **lutening hormone (LH)**. FSH stimulates spermatogenesis and sertoli cells to mould and nourish spermatids to produce spermatozoa .LH is an interstitial cell – stimulating hormone (ICSH), hence it stimulates the synthesis of testosterone by interstitial cells (Leyding cells) of the testis. Testosterone is largely responsible for initiating and maintaining the **secondary sexual characteristics** of the male. These include the growth of the sex organs, the growth of body hair (facial and pubic), deep voice and general muscular development. When the rate of spermatogenesis is high, **inhibin** (a glycoprotein hormone) is released which reduce the secretion of follicle stimulating hormone (FSH) from anterior pituitary gland by negative feedback control mechanism. On the other hand when the level of testosterone is high result into a decrease in secretion of lutenizing hormone (LH) from the anterior pituitary gland.

(07 marks)

**DR G MBASHI EDUCATION
WORKED EXAMPLE 5
BIOLOGY 1 - MARKING SCHEME**

1. a. **The well-known and accepted model of cell surface membrane**
- The accepted and well known model of the plasma membrane is called fluid mosaic model which was described by J. Singer and Garth Nicholson in 1972. (01 mark)
 - According to this model; the cell surface membrane is composed of phospholipid bilayer with proteins molecules float on it. (01 mark)
 - Due to its constant motion the membrane is not static rather dynamic; it is called “fluid” because it is thought that, the phospholipid bilayer is capable of much movement and also known as mosaic due to the arrangement of proteins in the phospholipid bilayer. (01 mark)
 - The membrane has pores which allow the passage of molecules into and from the cell. (01 mark)
 - The membrane has carbohydrates branching from the proteins called glycoproteins and branching from the phospholipids called glycolipids. (01 mark)
 - Moreover, the membrane also contain cholesterol that regulates the fluidity and flexibility of the membrane by disturbing the phospholipid bilayer. (01 mark)



Fluid mosaic model of the cell surface membrane

(Correct diagram - 04 marks)

- b. i. **Recognition** – glycolipid and glycoprotein.
 - ii. **Prevent freezing** – cholesterol.
 2. a. i. The proper biological name for the booster used is cofactor.
 - ii. **Activators** – these are inorganic ions which mould the enzymes active sites in a suitable shape that can form enzyme substrate complex more easily such as Cl^- in salivary amylase. (01 mark)
 - Prosthetic groups** are organic molecules that bind permanently to the enzymes and assist catalytic function such as haem in haemoglobin. (01 mark)
 - Coenzymes** are organic molecules that are loosely bind to the enzymes and act as hydrogen carriers such as NAD^+ . (01 mark)
- b. **In sterilization process**
The effect of detergents such as alcohols denature the proteins of the microorganism causing diseases and stops infection. (03 marks)

In preventing poisons

Fresh milk (undenatured protein) is taken by a person who accidentally swallow heavy metal poisons, the milk offers its charged protein which react with the heavy metals and form non-toxic substances. (03 marks)

3. a. The more realistic type of classification is **natural system**. (01 mark)
Reasons to support:
 - i. It considers many features in classifying organisms.
 - ii. Unrelated organisms are grouped different.
 - iii. Related organisms are grouped together.
 - iv. It considers the evolutionary relationship.

4 points @01 mark – 04 marks

- b.
 - 1.a. Organisms with wings2
 - 1.a. Organisms without wings3
 - 2.a. Organism with cerci.....Cockroach
 - 2.b. Organism without cerci.....housefly
 - 3.a. Organism with three distinctive divisions.....termite
 - 3.b. Organism with two distinctive divisions.....4
 - 4.a. Organism with antennae.....5
 - 4.b. Organism without antennae.....spider
 - 5.a. Organism with one pair of leg per body segment.....centipede
 - 5.b. Organism with two pairs of legs per body segment...millipede

5 points @ 01 mark – total 05 marks

4. a. The pressure of the water presses the ear drum inward causing pain since the pressure of water increased as the depth increases. *(02½ marks)*
- b. Blowing the nose in this way forces the air up the Eustachian tube thus increase the pressure in the middle ear. *(02½ marks)*
- c. Just as the inertia of the endolymph causes a deflection of a moving cupula when we start to spin, its inertia causes it to continue moving when we stop spinning, this deflects the cupula making us think we are still moving. *(02½ marks)*
- d. It deflects it in the same direction as we were spinning which would normally happen when we start to move in the opposite direction and the cupula is deflected by stationery endolymph. *(02½ marks)*
5. a. i. **Oxyntic cells** – they are found in the stomach (gastric gland) that play role in secretion of dilute hydrochloric acid. *(02 marks)*
- ii. **Goblet cells** – they are found in the walls of small intestine that play a role in secretion of mucus for lubrication. *(02 marks)*
- b. i. In shaded communities such as a woody, dawn and twilight.
- ii. A bright winter's day.

2 points @02 marks – Total 04 marks

6. a. This is because human usually respire using a mixture of substrates that is carbohydrates and lipids. *(01 mark)*
- b. Chemical substances which enter the mitochondria are pyruvate, oxygen, NAD^+ , adenosine diphosphate (ADP^+) and inorganic phosphate (Pi) and chemical substances that leave the mitochondria are carbondioxide, Adenosine triphosphate (ATP), reduced NAD and water. *(04 marks)*
- c. **Differences between aerobic respiration and photosynthesis:**

Aerobic respiration	Photosynthesis
Oxygen is used up	Oxygen is produced
Carbondioxide and water are released	Carbondioxide and water are used up
It decreases the dry mass	It increases the dry mass
It occurs in the mitochondria	It occurs in the chloroplast
It is a catabolic process	It is anabolic process
It takes place all the time	It takes place during the day
It occurs in plants and animals	It usual occur in photosynthetic organisms only.

Any 5 points @01 mark – total 05 marks

7. a. **Causes of hyperovulation**

- i. Application of fertility drugs such as clomiphene, which induces ovulation of more than one secondary oocyte.
- ii. Age of the mother, as the mother's age tend to increase, there is accumulation of FSH in their blood but the ovary slowly respond to these hormones in turn, ovulation of more than one secondary oocyte may result.
- iii. Hyperovulation is also triggered by a gene called "*twin gene*" which cause a woman to release more than one secondary oocytes in a single reproductive cycle.

3 points @ 01 mark - total 03 marks

- b. All individuals in each family could normally look alike because of the monozygotic twins who are identical twins, thus the human population could have increased so much because of the double addition of individuals in the population. *(01 mark)*

c. **Stages of birth in human**i. **Cervical dilatation**

This starts when the true labour starts in which the mother starts to reject the fully developed fetus; the uterine wall contracts and causing the cervix to dilate to about 10 cm wide. *(02 marks)*

ii. **Parturition**

This is actually delivery of the baby; it usual begins after fully dilatation of cervix and ends with birth of the baby, once the baby is out of the mother's womb, the umbilical cord is ligatured at two points and the cut is made between two ligatures allowing the baby to be totally separated from the mother physiological reliance. *(02 marks)*

iii. **Expulsion of placenta**

This is the removal of the placenta and associated membranes; it is also caused by the contraction of the uterus. The process occurs between 10 to 15 minutes after the delivery of the baby. This is important because if the placenta remains in the body for long time, its decomposition can lead to blood poisoning that may ultimately cause death of the mother *(02 marks)*

8. a. **Importance of glycolysis to the living organisms**

- i. It brings about the biodegradation of macromolecules such as glucose into pyruvate.
- ii. It synthesizes ATP at the substrate level.

- iii. It leads into the formation of pyruvate for fermentation or Krebs cycle.
- iv. It acts as interconversional centre for the intermediate compound such as glycerol.
- v. It involves in the formation of hydrogen carriers such as NADH.

5 points @01 mark - total 05 marks

b. The stages of glycolytic pathway

- i. **Phosphorylation of sugar** – this process activates the sugar and makes it more reactive, the activated sugar is then exposed to the glycolytic enzymes to proceed with the reaction.
- ii. **Lysis** – The phosphorylated 6C sugar is splitting into two molecules of 3C sugar phosphate.
- iii. **Oxidation by dehydrogenation** – Each 3C sugar phosphate is converted into pyruvate; this involves dehydrogenation making a reduced NAD molecule and production of two ATP molecules.

3points @ 02 marks - total 06 marks

- c. Lactic acid continues to increase in the blood after exercise even if anaerobic has ceased because it is removed from the muscles by the blood to the liver where it can be converted into pyruvate again.

(04 marks)

9. a. **Root pressure** is a positive hydrostatic pressure developed in the root due to differences in the osmotic potential between the soil and root cells. The root pressure is usually responsible for transporting water to the leaves of herbaceous plants and grasses.

(03 marks)

b. Blood as transport tissue:

- i. It transports gases such as oxygen and carbon dioxide.
- ii. It transports nitrogenous wastes such as urea from the liver to the kidneys.
- iii. It transports nutrients such as end products of digestion from the gut to other parts of the body.
- iv. It transports hormones from the endocrine glands to the target organs.
- v. It transports antibodies from the centre of production to the site of infection.

5 points @ 0½ mark - total 02½ marks

Blood as protective tissue:

- i. Antibodies present in the blood destroy pathogens.

- ii. It protects the infections caused by the pathogens such as white blood cells destroy the microorganisms that cause diseases which invade the body.
- iii. Platelets initiates blood clotting which prevents blood loss.

3 points @ 0½ mark – total 01½ marks

Blood as regulatory tissue:

- i. It regulates hydrogen ion concentration.
- ii. It regulated body temperature.
- iii. It controls water balance by transferring water to and from the tissues.
- iv. It regulates salt level required in the body.

4 points @0½ mark – total 02 marks

c. Circulatory system is a closed system because:

- i. Blood is confined to the vessel.
- ii. Blood circulates rapidly around the body due to high pressure.
- iii. Blood is not direct contact to the tissues.
- iv. The rate of blood flow can be controlled.
- v. The exchange of materials between the blood and tissues take place through the capillaries.
- vi. The distribution of blood can be adjusted.

Any 3 points @ 01 mark – total 03 marks

Lymphatic system is open system because:

- i. The fluid is not confined to the vessel.
- ii. Lack of pumping organ.
- iii. The fluid circulates slowly around the body.
- iv. The rate of fluid flow cannot be controlled.
- v. Fluid move under muscle movement force.

Any 3 points @01 mark – total 03 marks

10. Prophase I of meiosis I is regarded as the most important stage which occurs in sexually reproducing organisms only and it is the longest stage which is divided into five (5) phases; leptotene, zygotene, pachytene, diplotene and diakinesis. *(02 marks)*

- i. **Leptotene** – This initiates meiosis stage, in this stage chromosomes appear as uncoiled thread like and longitudinally and then become shorten, thick and visible. *(02 marks)*
- ii. **Zygotene** – This is initiated by the movement of homologous pair of chromosomes by the synaptic force of attraction called synapsis and lie side by side to form the bivalent chromosomes. *(02 marks)*

- iii. **Pachytene** - homologous chromosome repel to each other and separate partially except at one point of attachment is known as **chiasma** (plural; chiasmata). It is the site for exchange of genetic materials between the chromatids of homologous chromosomes, It is therefore brings about genetic variation hence evolution; This process is referred to as **crossing over**. It also hold the homologous chromosomes together while they move to the spindle fibre during metaphase. (02 marks)
- iv. **Diplotene** - The synaptic force of attraction starts to disintegrate and lapse and homologous chromosomes separate from each other. (02 marks)
- v. **Diakinesis** - the centrioles migrate to the opposite poles, the spindle fibres start to develop and nucleolus and nuclear membrane start to disintegrate. (02 marks)
Prophase I of meiosis I is regarded as most important stage because it is whereby chromosomes exchange their genetic materials leading to new gene recombination thus variation. (03 marks)