

BIOLOGY
(Theory)

NAMUNGOONA SALAF SCHOOL
UGANDA ADVANCED CERTIFICATE OF EDUCATION
PRE UNEB
BIOLOGY
(Theory)
Paper 2
2hour 30minutes

INSTRUCTION TO CANDIDATES

- *This paper consists of sections A and B*
- *Answer question one in section A plus three other questions from section B*
- *Any additional question answered shall not be marked*
- *Candidates are advised to read the questions carefully, organise their answers and present hem precisely and logically*

SECTION A (40MARKS)

1. Three experiments were conducted where mitochondria obtained from a highly respiring muscle tissue were placed in buffer solution and then incubated at 30°C

In experiment 1: The mitochondria were kept in buffer solution containing sucrose and inorganic salts

In experiment 2: The mitochondria were kept in buffer solution into which succinate was added and melonate added on the 6th minute.

In experiment 3: The mitochondria were kept in buffer solution into which succinate was added and sodium Azide added on the 6th minute

In each experiment 1 to 3, the concentration of dissolved oxygen was measured and the results shown in figures 1 and 2

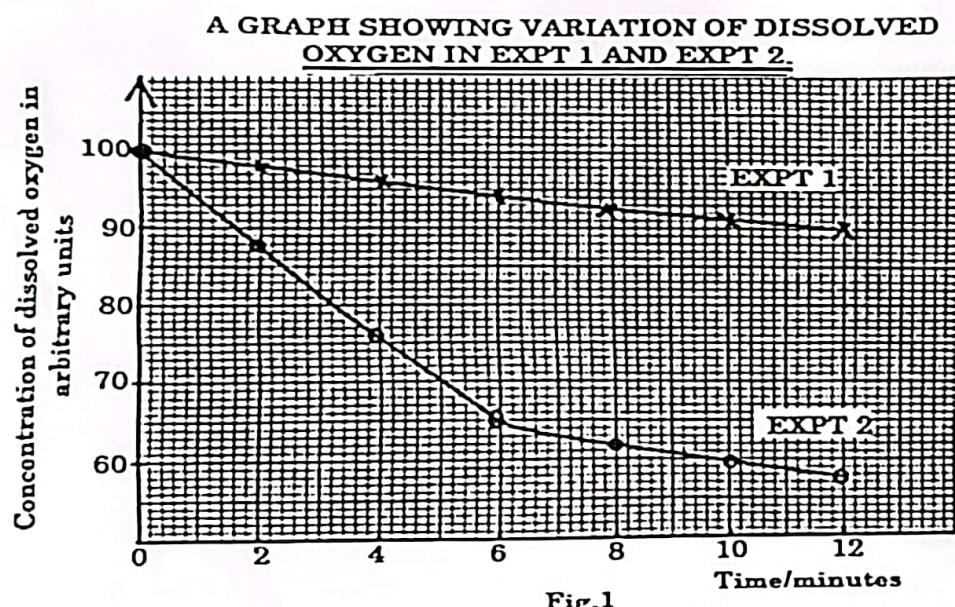


Fig.1

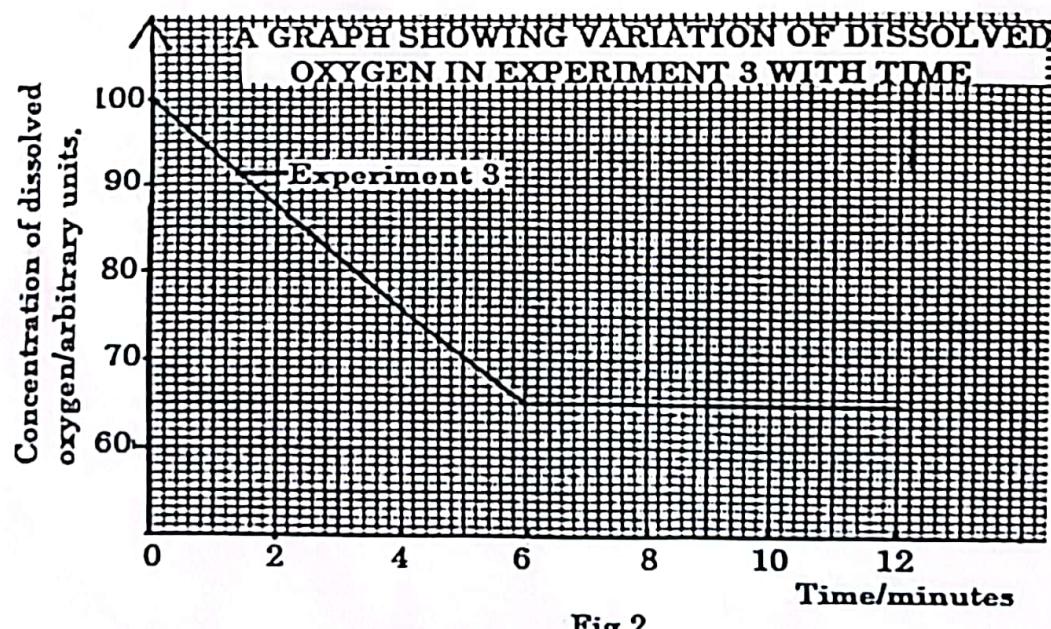


Fig.2

- a) Compare the concentration of oxygen in experiment 2 and 3. (05marks)
- b) Account for the
- i) Changes in the concentration of oxygen in experiment 2 (12marks)
 - ii) Effect of adding sodium azide in experiment 3. (04marks)
 - iii) Differences in concentration of dissolved oxygen in experiment 1 and 2. (08marks)
- c) Why were the mitochondria used in this experiment,
- i) Placed in buffer solution. (02marks)
 - ii) Obtained from highly respiring muscle tissue. (02marks)
- d) From figures 1 and 2, state the factors that influenced the experiment above.
- e) In what ways is energy production in mitochondria similar to that in a chloroplast. (04marks)

SECTION B (60MARKS)

Attempt only three questions

- 2.(a) Distinguish between reflex action and conditioned reflex (05marks)
- (b) How is the resting potential fully restored across the membrane of axon. (07mrks)
- (c) Explain the advantages of each of the following in behaviour,
- i) Releasers (04marks)
 - ii) Parental care (04marks)
- 3.(a) Outline the significance of excretion in mammals. (04marks)

(b) Describe the physiological differences that exist in osmoregulation between fresh water and marine bony fish (07marks)

(c) Account for the production of small volume of ^{Hyper tonic} hypotonic urine in a desert kangaroo rat. (09marks)

4.(a) Describe the path of carbon atom into a photosynthetic cell in a leaf of C₃ plant (06marks)

(b) Outline the events that are involved in incorporating the above carbon atom into a named polysaccharide. (08marks)

(c) Explain the effect of very high temperatures on the photosynthetic rates in c₃ plants (06marks)

5.(a) Describe the structure of a skeletal muscle. (05marks)

(b) Describe how the following processes occur in a skeletal muscle to cause movement

i) Excitation (07marks)

ii) Contraction (08marks)

6.(a) Describe the role of the following in protein synthesis

i) tRNA (03marks)

ii) mRNA (04marks)

(b) Compare protein synthesis and DNA replication. (08marks)

(c) Describe the characteristics of a genetic code. (05marks)

END

Candidate's Name LUCHU HAM

Signature GUIDE

Subject Paper code /.....

Random No.				
Personal Number				

SECTION A

(1)

a) Similarities

In both experiments 2 and 3, the Concentration of dissolved oxygen decreased between 0 and 6 minutes.

In both experiments 2 and 3, the Concentration of dissolved Oxygen was high initially at 0 minutes.

(02)

Differences

Between 6 minutes and 12 minutes, the Concentration of dissolved Oxygen in experiment 2 decreased gradually while the Concentration of dissolved Oxygen in experiment 3 remains constant.

(2k)

The Concentration of dissolved Oxygen in experiment 2 attained a lower minimum while the Concentration of dissolved Oxygen in experiment 3 attained a higher minimum.

(b)

From 0 minutes to 6 minutes, the Concentration of dissolved Oxygen decreased rapidly this because Succinate undergoes oxidative phosphorylation within the matrix of the mitochondria. Very many Hydrogen atoms are released which are accepted and carried by FAD to the inner mitochondrial membrane.

The Hydrogen atoms are passed from one hydrogen

UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022

Page 4 of 16

Do not
write
in this
margin

Candidate's Name
Signature
Subject Paper code /
Random No. | | | |
Personal Number | | | |

Carrier to another during hydrogen - carrier system until they reach Oxygen. They reduce more Oxygen molecules to form water in the final stage.

Between 6 minutes, and 12 minutes, the concentration of dissolved Oxygen decreased gradually because malonate is a competitive inhibitor, therefore competes with succinate for the active site of succinate dehydrogenase. Fewer succinate molecules are oxidatively dehydrogenated to fumarate; leading to production of fewer hydrogen atoms. Therefore, fewer Oxygen molecules are reduced during the hydrogen electron Carrier system.

Max (12)

b) ii)

When Sodium azide is added, the concentration of dissolved Oxygen remains constant between 6 minutes and 12 minutes, this is because Sodium azide is a non competitive inhibitor which inhibits Cytochrome Oxidase from catalyzing combination of electrons and protons within the electron hydrogen carrier system. Therefore, no hydrogen atoms formed hence no Oxygen molecules reduced.

Max (05)



**UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022**

Page 5 of 16

Do not write in this margin

Do not write in this margin

Candidate's Name

Signature

Random No.			
Personal Number			

Subject Paper code/.....

biii) The Concentration of dissolved Oxygen in experiment 1 is higher than that in experiment 2, this because succinate being an intermediate of the Krebs cycle is rapidly oxidatively dehydrogenated releasing very many Hydrogen atoms that reduce more Oxygen atoms molecules in the final stage during the electron hydrogen carrier system while sucrose being a disaccharide and not an intermediate of the Krebs cycle it is slowly dehydrogenated, therefore fewer hydrogen atoms are released hence very few Oxygen molecules are reduced to water!

08

c)

i) To suppress the rise in hydrogen ion concentration in solutions such that the optimum pH is maintained constant.

01

ii) Highly respiring tissues contain a lot of ATP molecules that readily provide energy during active pumping of the Hydrogen ions into the inner mitochondrial membrane

01

d)

- Concentration of dissolved Oxygen ✓
- Enzyme inhibitors ✓
- Nature of the respiratory substrate ✓

03



UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022

Page 6 of 16

Do not
write
in this
margin

Do
not
write
in this
margin

Candidate's Name

Signature

Subject Paper code/.....

Random No.			
Personal Number			

- e) In both ATP Synthesis is catalyzed by ~~ATPase~~ (iii)
- In both ATP Synthesis occurs in the ~~inner~~ membrane
 - In both ADP Combines with a phosphate unit to form ATP
 - In both Energy production is in form of ATP molecules
(Confirm)



Do not write in this margin

Candidate's Name

Signature

Random No.			
Personal Number			

Subject Paper code/.....

Do not write in this margin

SECTION B

2a)

Reflex action

It is not under the Voluntary Control of the brain

- It is Inborn

It is permanent

Response towards the stimuli is very fast

Response does not depend on the past experience

Response doesn't depend on a reward

Conditioned Reflex

Under the Voluntary Control of the brain

✓ It is both learned and Inborn

✗ It is temporarily.

✓ Response towards the stimuli is slow

✗ Response depends on the past experience

✓ Response depends on the reward

any (a) 5

b) After the firing of an ~~action~~ potential, ~~a~~ sodium ions gates close while potassium ion gates open, K^+ rapidly diffuse outside, the outside of the membrane becomes more positive while the inside becomes more negative, hence the membrane polarised, a slight delay in the closure of the K^+ gates results into continuous rapid diffusion of the K^+ outside the membrane leading hyperpolarisation of the membrane, then both

Na^+ and K^+ gates become closed and the Na^+ - K^+ pump begins to operate actively pumping $3Na^+$ outside and $2K^+$ inside the membrane, a negative potential difference of about -70mV develops across the membrane which is the resting potential.

Candidate's Name

Signature

Random No.				
Personal Number				

Subject Paper code/.....

(c) i) Releasers

- Control feeding where they enable organisms to search for food
- They ensure reproduction to occur among organisms of the same species where they initiate courtship and copulation
- Important in marking and defending territories from other organisms, this promotes security of resources and breeding
- They enable young ones to distinguish between their parents from predators. This enables them to be predicated on
- They are important in directing organisms during migration e.g. the bees

any 4

ii) Parental Care

Functions

Ensures that imprinting occurs successfully between the mother and the young ones e.g. in birds

Provides protection in form of immunity during breast feeding

- strengthens the love bond between parents and offspring

- Enable young ones to survive until maturity so chances of predation are few

5cf



08

UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022

Page 9 of 16

Do not
write
in this
margin

UACE

Do not
write
in this
margin

Candidate's Name

Signature

Subject Paper code

Random No.				
Personal Number				

3 a)

- To eliminate waste products of metabolism from the body.
- Improves the activity of enzymes where bi-products that act as enzyme inhibitors are removed
- Regulates pH of blood and tissue fluids through excretion of excess hydrogen ions in urine
- Promotes the constant production of useful products in enzyme controlled reactions whenever wastes are removed

524

b)

Higher filtration rates occur in fresh water fish than in marine bony fish as a result of rapid entry of water into their body by osmosis than in marine bony fish.

Fresh water fish excrete ammonia which requires a lot of water to be eliminated while marine bony fish excrete trimethylamine oxide which requires less water as to conserve water.

Fresh water fish have chloride secretory cells which actively pump salts from the surrounding into the body while the chloride secretory cells in marine bony fish pump salts from the body to the surrounding.

Fresh water fish have a decreased rate of reabsorption of water from renal fluid in kidney tubules hence pass out large volumes of very dilute urine while marine bony fish have a high rate of reabsorption.

UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022

Page 10 of 16

UACE

Do not write in this margin

Do not write in this margin

Candidate's Name

Signature

Random No.			
Personal Number			

Subject Paper code/.....

of water from the renal fluid of kidney tubules leading to production of less little urine which is hypertonic MAX 07

3(c) Desert specialist in water conservation)

The kangaroo rat experiences a challenge of obtaining enough water from the desert. In order to conserve water in its body, it has a very long loop of Henle to increase the surface area for absorption of water from the filtrate back to blood.

There is rapid active pumping of salts from the ascending limb into the surrounding tissues, this makes the medulla region hypertonic hence more water is reabsorbed from the tubules into the tissues by osmosis;

There is production of much Antidiuretic Hormone into blood from the posterior lobe of the pituitary gland when stimulated by the hypothalamus. The ADH increases the permeability of renal tubules mainly distal convoluted tubule and collecting duct, more water is reabsorbed back to blood.

09

Max



UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022

Page 11 of 16

UACE

Do not
write
in this
margin

Do not
write
in this
margin

Candidate's Name

Signature

Random No.			
Personal Number			

Subject Paper code /

4(a)

The Carbon atom enters the leaf through the Open stoma as Carbon dioxide. It diffuses through the intercellular spaces and dissolves in a thin layer of moisture then diffuses into the photosynthetic palisade mesophyll cells to reach the chloroplasts Xf

b) In the stroma of the chloroplasts; Carbon dioxide is accepted by Ribulose bisphosphate (RuBP) a reaction catalyzed by RuBP Carboxylase forming a six carbon intermediate which is unstable. It splits to form two molecules of Phosphoglyceric acid (PGA). The PGA is reduced by Hydrogen from Nicotinamide Adenine Dinucleotide Phosphate ($NADPH_2$) and phosphorylated by Adenosine triphosphate (ATP) to form a three sugar Phosphoglyceralehyde (PGAL). Two molecules of PGAL combine to form glucose which undergoes condensation to form starch Max 10

5

Very high temperature results in excessive water loss from the leaves leading to wilting. The water cells of wilted leaves secrete abscisic acid which inhibits stomatal closure. This leads to no carbon dioxide entering the leaves hence decreasing the rate of photosynthesis



UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022

Page 12 of 16

Do not
write
in this
margin

Candidate's Name

Signature

Random No.			
Personal Number			

Subject Paper code/.....

Very high temperature denature enzymes of C₃ plants easily preventing the catalysis of Carbon dioxide with RUBP Carboxylase.

High temperature promote photorespiration, this leads to RUBP Carboxylase Combining with oxygen instead of Carbon dioxide, Phosphoglycolate is produced hence the photosynthetic products reduced by a half.

Max 06

Q5 a)

The skeletal muscle consists of numerous elongated and cylindrical muscle fibres that contain numerous nuclei. The muscle fibres are striated and composed of many myofibrils which show a pattern of alternate light bands and dark bands, known due to presence of thick and thin filaments in them. The thin filaments are made up of actin and thick filaments are made up of myosin. The actin filaments are held together by Z-lines. The thick filaments are held by M-line. The distance between the two Z-lines is the functional unit of a muscle sarcomere. H-zone exists where only thick filaments occur.

Max 05



UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022

Page 13 of 16

Do not write in this margin

Do write in this margin

Candidate's Name

Signature

Subject Paper code

Random No.				
Personal Number				

5b) excitation

I) When an impulse reaches the neuromuscular junction, the presynaptic membrane becomes permeable to Ca^{2+} which diffuse into the presynaptic knobs and fuse with the vesicles. The vesicles rupture by exocytosis releasing acetylcholine which which diffuses through the cleft and settle on the receptor sites of the post synaptic membrane. This makes the membrane to become depolarised and forms end plate potentials that build up to threshold leading to firing generation of an action potential which is fired along the muscle fibre OR

II) Contraction

When the action potential is fired through the muscle fibre, Ca^{2+} are released from the T-Tubules into the Sarcoplasm, the Ca^{2+} dislodge tropomyosin from its binding site to dislodge tropomyosin from the binding site of myosin. ATP is hydrolysed by ATPase to release energy needed for the myosin head to bind with the actin filament forming the actomyosin bridge. During the process the myosin head detaches and re-attach to new position as the actin filaments slide past the stationary myosin heads and the muscle contracts.



Do not
write
in this
margin

D.
v
in
m

Candidate's Name

Signature

Random No.			
Personal Number			

Subject Paper code /

6(a)

i) tRNA

- Transfers amino acids to translation sites and
it ensures correct sequence of amino acids formed
due to pairing of its anticodon with the codon of mRNA
- tRNA holds amino acids in position ensuring
peptide bonds are formed between adjacent amino
acids. max 03

ii) mRNA

- Carries information of protein synthesis from the
nucleus to the cytoplasm,
- It allows synthesis of only required proteins at a particular
moment max 03

b)

Similarities

- DNA helicase ~~break~~ catalyses the breakdown of hydrogen bonds between the strands in both
- In both a nucleic acid is formed
- In both unwinding occurs
- Both occur in the ~~one~~ nucleus! max 03



UGANDA NATIONAL EXAMINATIONS BOARD
UGANDA ADVANCED CERTIFICATE OF EDUCATION
NOVEMBER - DECEMBER, 2022

Page 15 of 16

UACE

Do not write in this margin

Candidate's Name
 Signature
 Subject Paper code/.....

Random No.				
Personal Number				

Do not write in this margin

Differences

Protein Synthesis

- Uses part of the DNA
- Protein is formed
- RNA polymerase is used
- Products exit the nucleus
- Occurs in both nucleus and cytoplasm
- Use of ribosomes

DNA replication

- whole DNA used
- New DNA strand formed
- DNA polymerase is used
- Products remain in the nucleus
- Occurs only in the nucleus
- No ribosomes used

~~MAX 05~~

c)

- It is a triplet code, it has 3 bases coding for one amino acid
- It is degenerate, amino acids can be coded by more than one codon
- It is universal, a codon codes for the same amino acid almost in all living things
- It is non-punctuated, due to presence of a start and end codons separating genes from each other
- It is non-overlapping since a base belongs to only one codon but not another at ago

~~05~~

