

Each candidate should be provided with the following:

A freshly killed rat, labelled **X**.

20 cm³ of 20 volumes hydrogen peroxide, labelled solution **Q**.

2 M hydrochloric acid solution, labelled solution **P**.

2 M sodium hydroxide solution, labelled solution **R**.

Medium sized Irish potato, labelled **S**.

6 cm³ of 0.6 M commercial sucrose solution, labelled solution **T**.

Bread mould, labelled **E**.

Lichen, labelled **F**.

Whole fern plant, labelled **G**.

Dissecting kit, pins, board and cotton wool.

Stop clock.

4 plastic beakers (100 cm³ - 250 cm³).

Thermometer.

Ruler (15 cm – 30 cm long).

6 test tubes.

10 ml measuring cylinder.

50 ml measuring cylinder.

2 Droppers.

Labels.

Mortar and pestle.

Knife.

Filter paper.

Glass rod.

Hand lens.

Light microscope, slides and cover slips.

Razor blade.

A piece of thread (1.5 m long).

A petri dish.

Access to:

- Distilled water.
- Reagents for carrying out food tests.
- Source of heat.
- Hot water/water bath.

Candidate's Name:MATOVU AHMED.....

Signature: Suggested guide

Random No.					Personal No.		

(Do not write your School/Centre Name or Number anywhere on this booklet.)

P530/3

BIOLOGY

(Practical)

Paper 3

Nov./Dec. 2023

3½ hours



UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

BIOLOGY
(PRACTICAL)

Paper 3

3 hours 15 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of three questions.

Answer all the questions.

Write the answers in the spaces provided. No additional sheets of paper should be inserted in this booklet.

You are not allowed to start working within the first 15 minutes. You are advised to use this time to read through the paper and ensure that you have all the apparatus, chemicals and specimens you require.

For Examiners' Use Only		
Question	Marks	Examiner's Signature & No
1	40	M-A
2	35	M-A
3	25	M-A
Total	100.	M-A

1. You are provided with a freshly killed specimen X.- Rat

(a) (i) Giving **three** reasons, state the class to which it belongs.

(04 marks)

Class ... Mammalia ✓ Rej: mammal/mammalian/
wrong sp.

Reasons

- Has pinna/pinnæ/outer ear/external ear/.....
.....external ear lobes. ✓ Rej: ear
- Possession of fur/hair. ✓
- Possession of external genitalia/external sex
.....organs. (Accept external reproductive structures)
- Has nipples/teats. ✓

04marks

(ii) Open the mouth of specimen X and examine the teeth. What
special teeth adaptations do you observe? (04 marks)

- Long/elongated incisor teeth for deep cutting into food ✓
- Chisel shaped/sharp edges incisor teeth for easy.....
.....cutting of food. ✓
- Curved incisor teeth for easy scooping/extension/grawing
of food. ✓
- Pointed/tapering/sharp incisor teeth for easy cutting. ✓
- Molars with large/broad crowns with many cusps to
increase surface area for grinding of food. ✓
- Rough cusps on the molar surface for increased/
easy grinding of food. ✓
- Ridge/molten surface for easy grinding of food. ✓
- Numerous molar teeth to increase surface area for grinding. ✓

Award any four correct points. 08marks

- (iii) View the head of specimen X from the dorsal side and state how the features are suitable for environmental perception.

- Large/broad pinna/pinnae/ear lobes/outer ear (05 marks)
to increase surface area for trapping sound waves ✓
- Funnel shaped/Pinnae curved at the base for easy collecting/directing/concentration of sound waves into ear canal of auditory canal.
- Numerous whiskers/vibrissae to increase surface area for sensitivity/perception. ✓
- Award 05 marks.
- Award any five correct points.
- Numerous whiskers/vibrissae of variable length to increase chances of detection. ✓
- Long vibrissae/whiskers to detect at a distance ✓
- Stiff vibrissae for increased sensitivity ✓
- Large/protruding eyes to increase surface area for a wide field of view. ✓

- (b) (i) Dissect specimen X to open the abdominal cavity. Carefully disentangle the alimentary canal without causing much bleeding. Ligature the hepatic portal vein to prevent much bleeding. Stretch out the full length of the alimentary canal from the cardiac end of the stomach to the posterior end of the colon.

Measure the length of each portion of the alimentary canal as indicated in table 1, record your results in the table and complete the table.

Table 1 (06 marks)

Portion (along outer part)	Length (mm)	Percentage length of each section
stomach	30 - 83 ✓	3.53 ✓
duodenum	80 - 157	9.42
ileum	680 - 1080	80.09
caecum & appendix	32 - 100.	3.77.
colon	27 - 90.	3.18
full length	849 - 1510.	100. 06 marks

11 marks

(ii) What is the significance of the observed differences in the length and shape of the different portions of the alimentary canal?

Stomach

(2 1/2 marks)

Short, curved/c-shaped/c-curved/J-shaped
for temporary storage of food
Short/shorter for quick/fast passage of food.

0.25

Duodenum

(02 marks)

Long/relatively longer, curved/c-shaped/U-shaped
loop shaped to increase surface area for
food digestion/storage.

0.2 max

Long to allow longer time for digestion of food

Ileum

(02 marks)

Very long/longer/longest, long coiled/entangled
increase surface area for storage/digestion and
absorption of food.

0.2 max

Long to allow longer time for digestion and absorption
of food

Cæcum and appendix

(02 marks)

Short, curved/tapers (towards appendix) for
temporary storage of food

0.2 max

Colon

(1 1/2 marks)

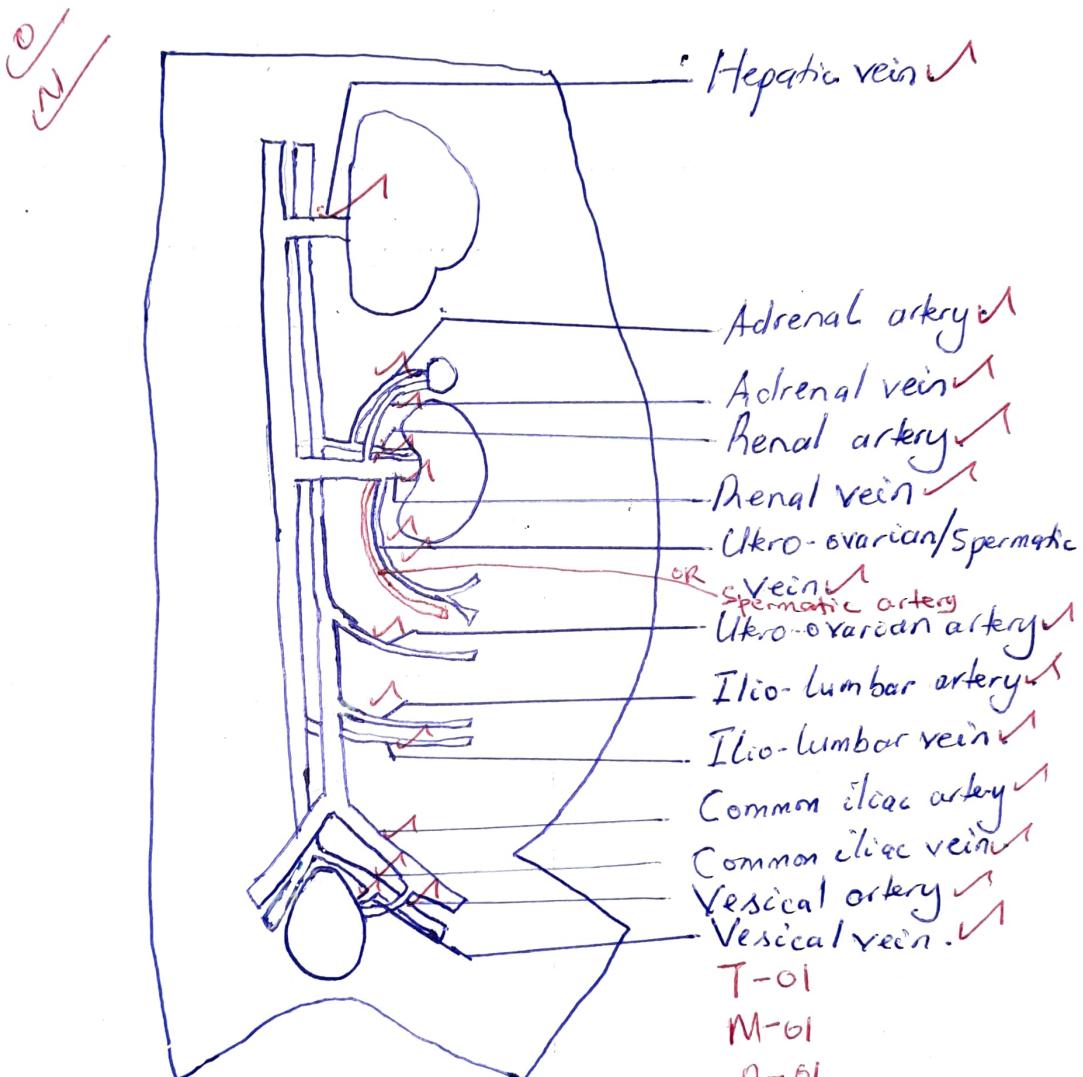
Short, curved/less straightened for temporary
storage of undigested food/wastes/unwanted materials.
Shorter for fast/quick passage of undigested food.

1.0 max

- (c) Proceed with the dissection by removing the unnecessary structures in order to display the major blood vessels of the left side of the abdominal cavity.

Draw and label the major blood vessels displayed. (12 marks)

A drawing showing the major blood vessels/major veins and arteries on the left side of the abdominal cavity of specimen X.



X1 → X3 ✓

41

40 max
5

12

Turn Over

- ~~3M HCl~~
~~2M NaOH~~
 Irish Potato
 20 cm³ of 20 vol. H₂O₂.
2. You are provided with solutions; P, Q, R and specimen S. Solutions P and R provide different pH media.
- (a) (i) Label four beakers; A₁, A₂, A₃ and A₄, and prepare their corresponding solutions as shown in table 2.

Table 2

Solution (cm ³)	Volume of solution Q (cm ³)	Volume of water added (cm ³)
A ₁	7	7
A ₂	4	8
A ₃	5	30
A ₄	1	11

- (ii) Cut a cube from specimen S measuring 3 cm × 3 cm × 3 cm. Chop the cube into smaller pieces and crush them into a paste using a mortar. Add 10 cm³ of distilled water and decant the extract of specimen S in a petri dish and label it extract S.
- (iii) Obtain six test tubes and label them as A₁, A₂, A₃, A₄, A₅ and A₆. Pour 10 cm³ of the solutions A₁, A₂, A₃ and A₄ into the corresponding test tubes.
- (iv) Pour 10 cm³ of solution A₃ into each of the test tubes A₅ and A₆. Add five drops of solution P to the content of A₅ and five drops of solution R to the content of A₆.
- (v) Cut six pieces of filter paper each measuring 0.5 cm × 0.5 cm. Dip the filter papers into extract S and leave them to stay in the extract for five minutes.
- (vi) Pick one filter paper from extract S and gently dip it into the solution in test tube A₁, and start the stop clock immediately.
- (vii) Record your observations and time taken for the paper to rise to the surface in table 3.
- (viii) Repeat procedure (vi) - (vii) using solutions in test tubes; A₂, A₃, A₄, A₅ and A₆.

Table 3

(11 marks)

Test Tube	Content	Observations	Time taken for paper to return to surface (seconds)
A ₁	Solution A ₁ + filter paper	Very rapid / Very fast effervescence or bubbling / very many bubbles Paper rises very fast ✓	3 - 15 ✓
A ₂	Solution A ₂ + filter paper	Rapid / fast effervescence / Many bubbles. ✓ Paper rises fast ✓	4 - 16 ✓
A ₃	Solution A ₃ + filter paper	Moderate effervescence / Moderate number of bubbles. ✓ Paper rises moderately ✓	7 - 24 ✓
A ₄	Solution A ₄ + filter paper	Slow effervescence / bubbling / few bubbles. ✓ Paper rises slowly ✓	13 - 35 ✓
A ₅	Solution A ₃ + P + filter paper	Very few bubbles / No bubbles / very slow bubbling / effervescence ✓ Paper slightly rise & sunk. Paper did not rise ✓	Infty / ✓
A ₆	Solution A ₃ + R + filter paper	Moderately slow effervescence / moderately fewer bubbles. ✓ Paper rose moderately slow. ✓	10 - 26 ✓

Rate of reaction should decrease from A₁-A₄. Compare A₅&A₆.

(b) Explain the results in the following test tubes.

(i) A₁ Extract S contains enzyme/active substance/organic catalyst/biological catalyst/Catalase ✓
 A₁ contained the highest/very high concentration of substrate/hydrogen peroxide resulting into very many chances of collision between enzyme and substrate molecules ✓
 hence the very high rate of decomposition/breakdown of other substrates/solutions & Very high enzyme activity/very high rate of reaction ✓

Rej: Hydrolysis for decomposition.

15 marks

(ii) A₃ (03 marks)

A₃ contained moderate substrate concentration ✓ resulting into moderate chances of collision between enzyme and substrate molecules hence the 03 moderate breakdown of substrate ✓

(iii) A₄ (03 marks)

A₄ contained low concentration of substrate concentration ✓ resulting into few chances of collision between enzyme and substrate molecules hence the low rate of breakdown/decomposition of substrate. 03 marks

(iv) A₅ (03 marks)

A₅: Very low/no enzyme activity because solution P provides slight inhibits enzyme activity / provides unsuitable/unfavorable medium / pH for enzyme activity ✓ 02marks

(v) A₆ (03 marks)

Moderately slow enzyme activity because solution P provides a slightly favourable/suitable medium / pH for enzyme activity / for decomposition ✓ 02marks

breakdown by enzyme.

- (c) (i) Explain the significance of the reactions in the experiment to multicellular organisms. (05 marks)

Hydrogen peroxide is toxic/poisonous by product of metabolism and decomposition or breakdown into water and oxygen by catalase detoxifies, renders it harmless thereby protecting the cells/tissues from its harmful effects.

Multicellular organisms should regulate pH for proper enzyme functioning. (06 marks)

- (ii) How were errors minimised during the experiment? (03 marks)

- Usage of same size of filter paper to ensure constant concentration of enzyme.
- Using one soaked filter paper per solution to ensure constant concentration of enzyme.
- Same duration of soaking the filter paper into the extract so that they absorb same concentration of enzyme.
- Cutting the filter paper pieces from the same filter paper to ensure same absorption capacity of the enzyme.
- Usage of same volume of substrate to ensure same uniform height/distance of movement of filter paper.
- Usage of extract from same cube to ensure same/constant enzyme concentration.
- Usage of the same size/diameter of test tube to ensure equal distance of movement of filter paper.

Bread Lichen white R

You are provided with specimens; E, F and G.

3.

- (a) Mount a small portion of specimen E in a drop of water and observe under low power of a light microscope.

- (i) Giving two reasons, state the division to which specimen E belongs. (03 marks)

Division Zygomycota / Zygomycetes ✓ Rej: wrong sp.

Reasons - Sporangium / spore case ✓ Rej: Spore capsule

* First two reasons - Sporangiophore / Vertical hyphae ✓

- Stolon / Linking / Horizontal Hyphae ✓ - Non septate / aseptate.

- Rhizoids / Rooting hyphae ✓ - Branched mycelium / hyphae.

- (ii) From your observations, state how the features of specimen E ensures its survival in the habitat. (03 marks)

Any 6 ✓

- thin / slender rhizoids to reduce / minimize diffusion distance for absorption of nutrients.
- thin rhizoids for easy penetration into substratum for nutrient absorption / anchorage.
- Numerous / many rhizoids for easy penetration into substratum for anchorage.
- long sporangiophore to raise sporangium high for easy dispersal of spores to increase chances of propagation.
- large / swollen sporangium to increase surface area for storage / production of spores to increase chances of propagation.
- Branched stolons / linking hyphae for faster colonisation.
- Numerous spores to increase chances of propagation.
- Small spores which makes them light to be easily blown by wind.
- Many sporangia to increase surface area for production of spores to increase chances of colonisation / propagation.

- (b) (i) Using a hand lens, examine the upper surface of the pinna of specimen G. Describe the role of the observable structures in the survival of the organism. (04 marks)

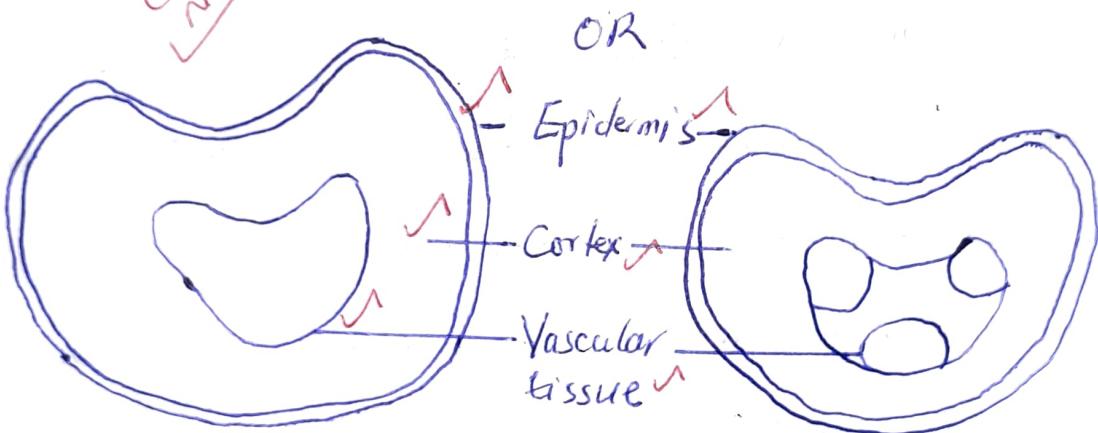
- Numerous pinnules to increase surface area for absorption of light for photosynthesis.
- Numerous veins for increased surface area for support / for increased support.

02 marks

- , Numerous hairs to reduce rate of transpiration ✓
- , Numerous sori/numerous sporangia for storage of numerous spores to increase surface area for storage of spores. ✓

(ii) Cut a thin transverse section of the rachis of specimen G. Observe under low power of a light microscope. Draw and label the tissue plan observed. (07 marks)

A drawing of the tissue plant of the transverse section of the rachis of specimen G observed under low power ✓



X30 - X100 ✓

T-01	
M-01	
O-01	
N-01	
D-01	
L-01	
<hr/>	
07	

(c) Use a hand lens to examine specimen F.

(i) Describe the structure of specimen F.

(04 marks)

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.....

Any four 04 marks

(ii) Explain the ecological significance of specimen F. (03 marks)

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03 marks.

25

07 marks