1. **75 MINUTES (40 marks)** Suggested NAKISSHA 2022.

You are provided with a freshly killed cockroach labeled **K**. Examine the external features of the specimen using a hand lens wherever necessary.

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a) Describe the structure of the following parts:-

(i) Exoskeleton on the abdomen. (03 marks)

2 cuticles, ~~thin~~, broad, ~~soft/closely~~ ~~slippery~~, hard/chitinised/sclerotinised, with many/10 overlapping segments. Cuticles taper posteriorly with ventral cuticle curved outwards/boat shaped and dorsal cuticle flattened. Accept: Dorsal ventrally flattened cuticle. Any 6 @ 0.5

(ii) Tarsus. (03 marks)

5 uneven segments/1st and 5th long and rest shorter with the inner segments have soft pulvilli/plantulae at the joints, hairy with a large round arolium and 2 sharp/pointed curved claws. Any 6 @ 0.5

(iii) Antennae. (03 marks)

2 long, thin, hairy, tapering towards their tip and segmented with broad base, cylindrical. Reject: colour, glossy, texture eg ~~soft~~, slippery. @ 0.5

*Reject colour ~~etc~~ @ ½

b) Give **two** benefits each part in (a) derives from its structure as described above.

(i) Exoskeleton on the abdomen. (02 marks)

1. Hard cuticles for increased protection.
   Segmented cuticles for ~~increased protection~~ ~~increased flexibility~~
2. ~~*Stopperts to easily escape predators/to easily~~ enter cracks
   Dorso-ventrally flattened to easily pass through cracks.

(ii) Tarsus. (02 marks)

1. Segmented for increased flexibility
   Plantulae/Arolium produces sticky fluid for easy attachment on ~~soft~~ smooth surfaces
2. Pointed claws for firm attachment on rough surfaces.

(iii) Antennae. (02 marks)

1. Long to sense at a distance/all over the body
   Segmented for increased flexibility
2. Tapers to reduce weight for easy swing
   Broad at base for firm attachment.

*Reject use of help, aid, facilitate, enable, allow
*Consider first 2.

c) Pin the specimen with dorsal side uppermost. Dissect along one side of the abdomen to display the internal structures. Clear off any unnecessary tissue taking care not to displace any abdominal part.

15

(i) Draw the ventral cuticle and visceral internal parts of the digestive system at this stage of dissection. (10 marks)

A drawing of internal structures on ventral cuticle of digestive system in abdomen without displacement of specimen K/Cockroach.

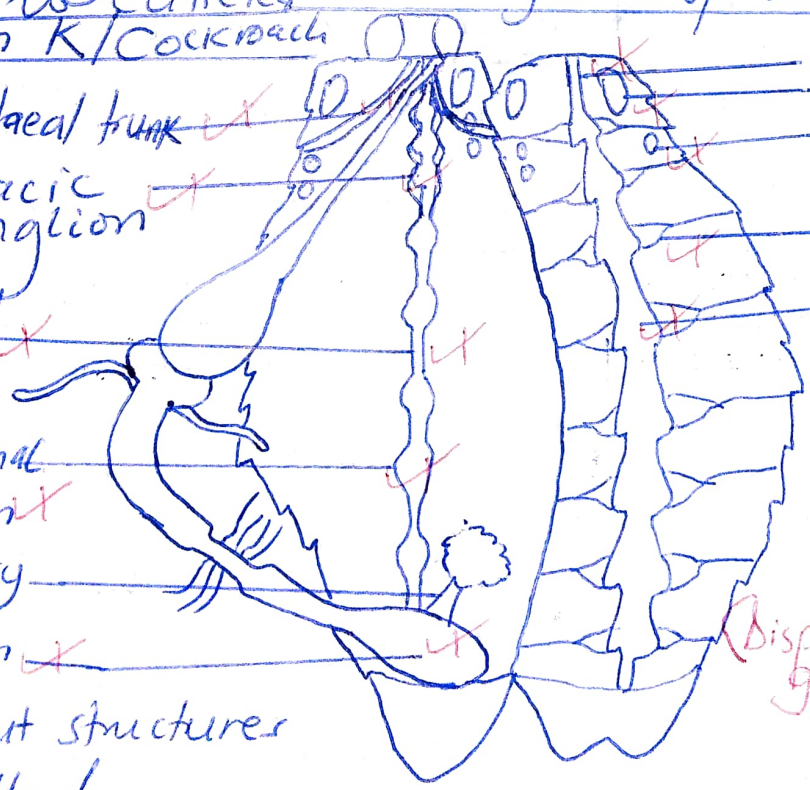
NA. If thoracic structure labelled
. Both cuticles drawn/not
. Oesophagus labelled in thoracic region.
. External structures labelled
. Digestive system beyond midline
. Dorsal cuticle labelled.
IRh-Only dorsal cuticle drawn

XI-3

T-01
M-01
O-01
N-01
D/L-05
A-01
UD-01
10

(ii) Proceed to dissect and expose the complete Alimentary canal and displace it to the left of the specimen to display the internal structures.
Draw and label internal structures which are attached to the cuticle. (15 marks)

A drawing showing internal structures attached to cuticles with gut displaced to left of specimen K/Cockroach



Ignore ~~NA-If~~ gut structures labelled.
NA-External structures labelled.

XI-3

T-01
M-01
O-01
N-01
D/L-10
(Displaced gut) D/G-01
15

25

KEEP THE SPECIMEN K FOR No. 2

Turn Over

2. **60 MINUTES (30 marks)**

You are provided with solutions **V_1 and V_2** of complex nature and different concentrations.

(a) Cut and remove the following parts from your dissection in Question 1 and place them on glass slides labeled: **W**-flight muscles, **X**-mandibles and **Y**-foregut.

(i) Carry out the procedures in table 1 and record your observations and deductions. (10 marks)

EXPERIMENT	OBSERVATIONS	DEDUCTIONS
1- To half of **W** in a test tube, add 2cm³ of V_1	Many bubbles of a gas/Much effervescence at a fast rate.	Fast breakdown of V_1
2- To remaining half of **W** in a test tube, add 2cm³ of V_2	Very many bubbles of a gas at a very fast/faster rate	Very fast breakdown/decomposition of V_2
3- Repeat procedure in **1** above using **X** instead of **W**	Few/No bubbles of a colourless gas evolved	Slow/No breakdown of V_1
4- Repeat procedure in **1** above using half of **Y** instead of **W**	Moderate bubbles of a colourless gas evolved at moderate rate.	Moderate breakdown of V_1

Accept comparison.

* Reject Hydrolysis.

(ii) What was investigated in experiments 1 and 2. (01 marks)

Effect of varied concentration of substrate/V_1 and V_2 on rate of breakdown by active substance in W/flight muscle

Explained the results obtained in 1 and 2 above. (04 marks)

W contained active substance which catalysed breakdown of complex substrate V_1 and V_2. V_1 of lower concentration is broken down slowly, while V_2 of higher concentration at a faster rate.

(iii) Explain the differences(if any) in results obtained for the different body parts from specimen **K** in :-

Experiment 1: (2 marks)

W which is a flight muscle is metabolically active hence contains high concentration of active substance which catalyses breakdown of substrate V_1 but a fast rate.

Experiment 3: (2 marks)

X - mandibles made up of exoskeleton, not metabolic active had few/No active substance for catalysing breakdown of V.

Accept Some muscles attached on mandibles hence few active substance/less metabolic

Experiment 4:

Y - fore gut, moderately active hence contained moderate concentration of active substance which catalyses moderate breakdown of V_1. (2 marks) 02

(b) Boil the remaining foregut from **Y** and subject the same quality of substance **Z** to excessive heat for 2 minutes. Allow to cool and carrying out the procedures in table 2 below, record your observations. (03 marks)

EXPERIMENTS	OBSERVATIONS
To boiled foregut add 2cm³ of V_2	No bubbles of a ~~of~~ colourless gas evolved
To heated substance **Z** add 2cm³ of V_2	Many/Much/Very many/Rapid bubbles evolved at a fast rate with release of heat. 04

(i) Giving a reason for your answer, suggest the nature of substance **Z.** (2 marks)

Z is an inorganic active substance since it is not affected by excessive heat. 02

(ii) Explain the results in table 2 above. (4 marks)

Boiling foregut denatures the active substance so complex substrate V_2 is not broken down while excessive heat has no effect on substance Z so it catalyses breakdown of substrate V_2 at fast rate. 04

12

30

3. (30 marks)

You are provided with specimen **S** and **T**. Observe Specimen **S** using a hand lens and the internal structure of specimen **T**. ½ onion bulb cut longitudinally.

(a) Describe:-

(i) Specimen **S** (03 marks)

Thin, Long, cylindrical, flexible, buoyant and green coloured filament. 03 max

(ii) The internal structure of specimen **T** (03 marks)

Numerous layers of thick, fleshy leaves which tapr towards apex and base. fleshy leaves curve inwards, reduce towards inner side, closely packed with buds in centre 03 max

(b) Peel a strip of colored epidemics from one fleshy leaf of specimen **T**. Mount in a drop of water on a glass slide and observe at medium power magnification after three minutes. Prepare another mount using one filament of specimen S and observe at same magnification.

(i) Give **three** differences and similarities observed in the cells from the two specimens. Consider First three in each (03 marks)

Differences:

Cells from S	Cells from T
1- Chloroplast present	Chloroplast/Pyrenoid absent
2- Larger central vacuole	Smaller vacuole
3- Fewer cells, Rectangular cells, Uniform sized cells	Many cells, Hexagonal cells, Varied sized cells

03

Similarities: (03 marks)

1. Both, double layered cell wall, single vacuole
2. , rectangular shaped cells
3. , cells in contact with each other 03 max

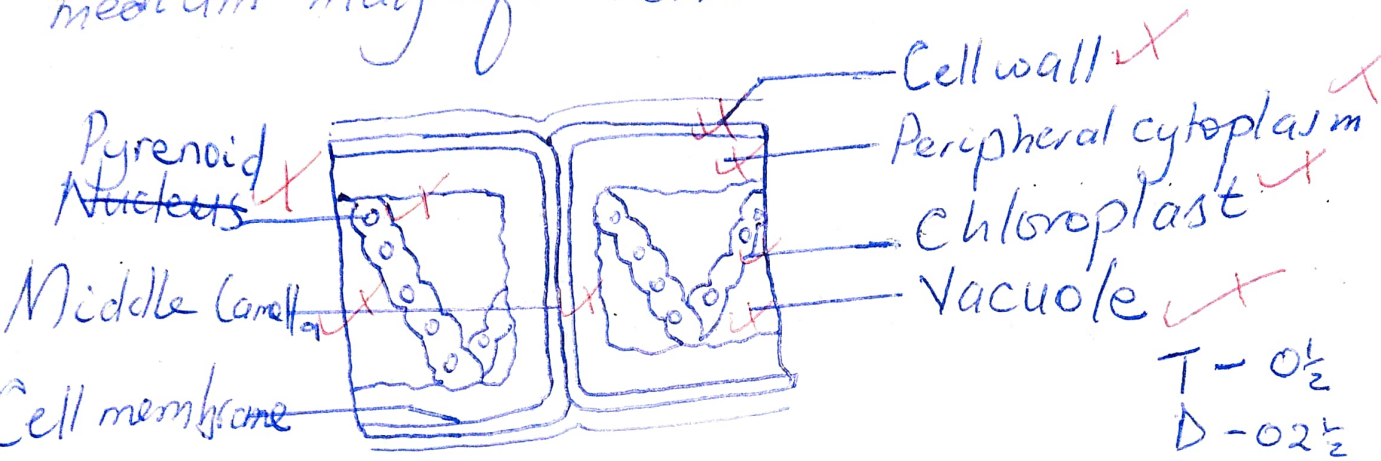
(ii) Observe another coloured epidermis from specimen **T**, but using a drop of solution **U** instead of water (observe after three minutes in solution **U**)
Record and explain any difference in appearance of the coloured portion in the cells from water and that from solution **U**. (0.7M sucrose solution) (05 marks)

Epidermis is pale coloured in water and deep coloured in solution U. Water is hypotonic to cell sap (high water potential) hence ~~lose~~ water absorbed by osmosis diluting the purple colour leading it to expand while Solution U was hypertonic to cell sap causing it to lose water by osmosis concentrating the coloured portion and making it to shrink in size. 05

17

(iii) Draw the part where two cells of specimen S are joined to each other and label the structures seen clearly under medium power magnification. (06 marks)

Drawing of the part where two cells of specimen S are joined to each other under medium magnification.



T – 0½
D – 02½
L – 02½
M – 0½
06

X200 – 400

NA – Nucleus and cytoplasmic strand drawn and labelled.
– One cell drawn.

06

(i) Assuming the diameter field of view at medium power(x100) is approximately 1.5mm, estimate the actual surface area of one cell of specimen **S** in micrometer^2.

Show your method.

Diameter field of view in micrometers = 1.5x1000 = 1500μm
Number of cells of S along diameter = 8-12 cells.
Actual length of one cell = $\frac{1500}{\text{number of cells}}$ = 125-187.5μm

04

10

(05 marks)

(ii) Suggest the adaptive significance of the large surface area of cells in a filament to specimen S.

(02 marks)

Increased/Large surface area means more chloroplasts exposed to trap more light energy for maximum photosynthesis; rapid absorption of nutrients and gases and loss of excretory products. Q3

Accept for floatation/buoyancy.

Mably pyrenoids for increased surface area for storage.

30

END