

Each candidate should be provided with the following:

A freshly killed cockroach, labelled **Z**.

35 cm³ of solution **Q**.

(Solution **Q** is prepared by dissolving 342.3 g of commercial sucrose in 1 litre of distilled water.)

10 cm³ of 1 % H₂O₂ solution in a boiling tube, labelled **S**.

A large Irish potato, labelled **P**.

2 bean seeds soaked in wet cotton wool for 48 hours, labelled **R**.

Inflorescence of :

- *Bidens pilosa*, labelled **H**.
- *Bougainvillea*, labelled **I**.
- *Lantana camara*, labelled **J**.

Dissection board, kit and pins.

8 test tubes.

A measuring cylinder (10 ml).

A thermometer.

A plastic beaker (250 cm³).

A stop clock.

A petri dish.

5 mm cork borer (size 5).

Mortar and pestle.

Dropper.

Razor blade.

Labelling paper.

2 Filter papers.

A light microscope, slides and cover slips.

Hand lens.

A thread (30 cm long).

Access to:

- reagents for food test.
- source of heat.
- distilled water.
- hot water.

Candidate's Name: **MATOVU AHMED**

Signature:

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. 2022

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	MA
2	35	MA
3	25	MA
Total	100	MA

1. You are provided with specimen Z, which is freshly killed. Examine the external features using a hand lens where necessary.

- (a) Giving reasons, state the order to which specimen Z belongs. (05 marks)

Order Dictyoptera ✓ Accept Blattidae. Rej: wrong sp.

Reasons: Has a pair of anal cerci.

Elongated / long slender / thin / wire-like / thread like / filiform antennae.

thick narrow outer / fore / anterior wings / general and thin / membranous broad inner / hind / posterior wings ✓

Dorsal ventrally flattened body. ✓ Any 4 Q5

Presence of mandibles ✓ Rej biting / chewing mouth parts.

- (b) Measure the width of the widest region of the head, thorax, abdomen and then measure the width of the last abdominal segment of specimen Z in millimeters. Record your measurements in table 1. State the significance of the measurements obtained in relation to the life of the specimen.

Table 1

(04 marks)

Part	Width (mm)	Significance of the measurements
Head	3.5 - 7 ✓	Streamlined body from anterior / front end to minimise resistance during locomotion / to ease locomotion / flight / running / walking ✓
Thorax	7 - 18 ✓	
Abdomen	11 - 21 ✓	
Last abdominal segment	3 - 6 ✓	

Q5 marks

- (c) (i) Detach one fore limb and one hind limb from specimen Z. Stretch them out and measure the length of each limb in millimeters. Record your measurements in table 2 and determine the ratio of the fore limb to hind limb.

Table 2

(02 marks)

Limb	Length (mm)	Ratio
Fore limb	22 - 26 ✓	1:2 ✓ Accept 0.5
Hind limb	42 - 50 ✓	Reject ratio if not simplified. ✓

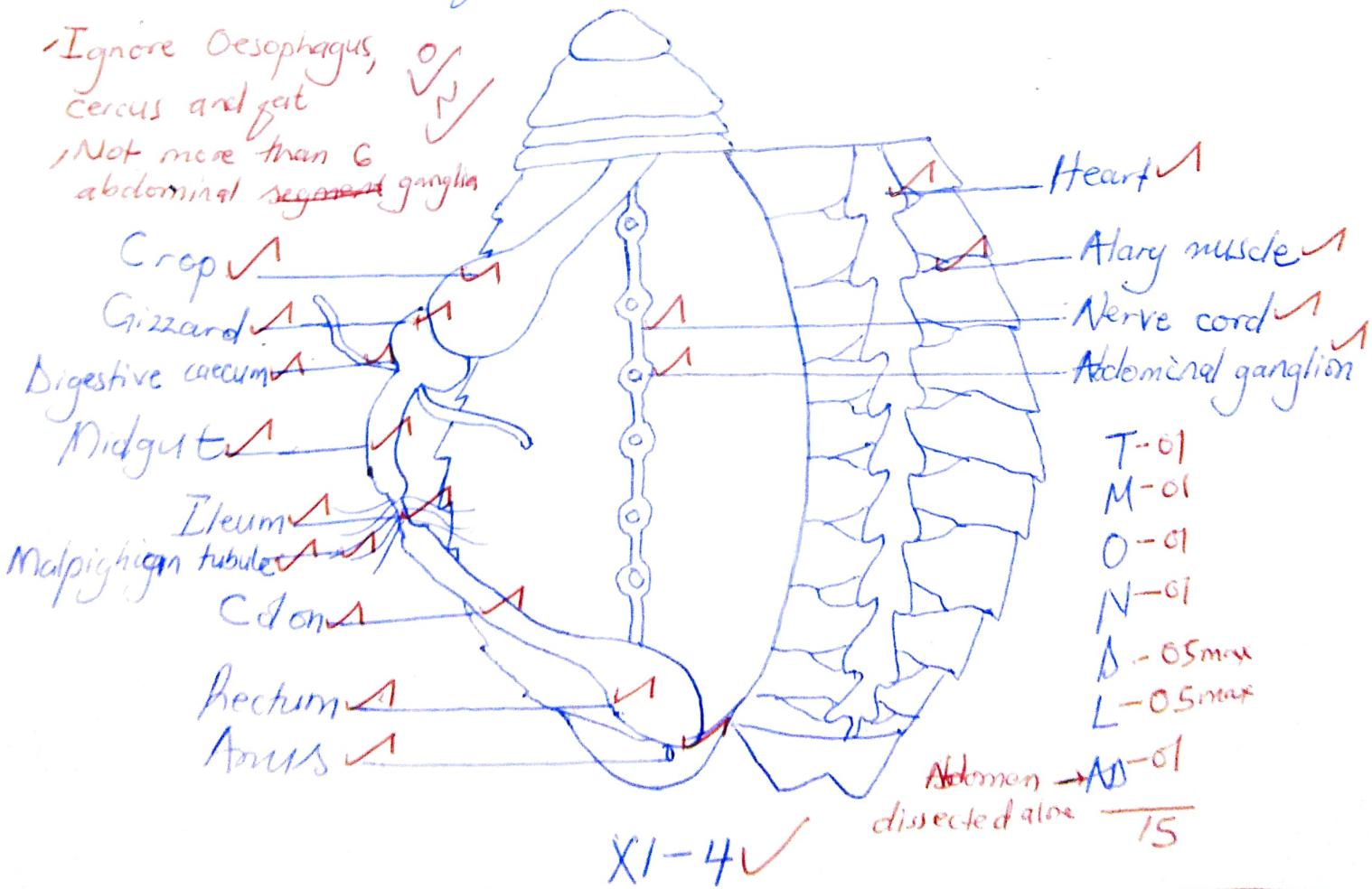
Q3 marks

- (ii) Explain the significance of the ratio in table 2 to the life of the specimen Z. (3½ marks)

Longer hind limb / hind limb twice the length of the fore limb for generation of greater / stronger propulsive force ✓
 Shorter fore limb / fore limb half the length of the hind limb to absorb shock on landing ✓ Award comparison one 03 marks

- (d) Dissect specimen Z along the left lateral line to display the viscera in the abdomen of the specimen. Remove any pieces of odd fatty tissue present. Draw and label the structures displayed excluding the reproductive structures. (14 marks)

A drawing of the structures/viscera in the abdomen of specimen Z / Cockroach ✓



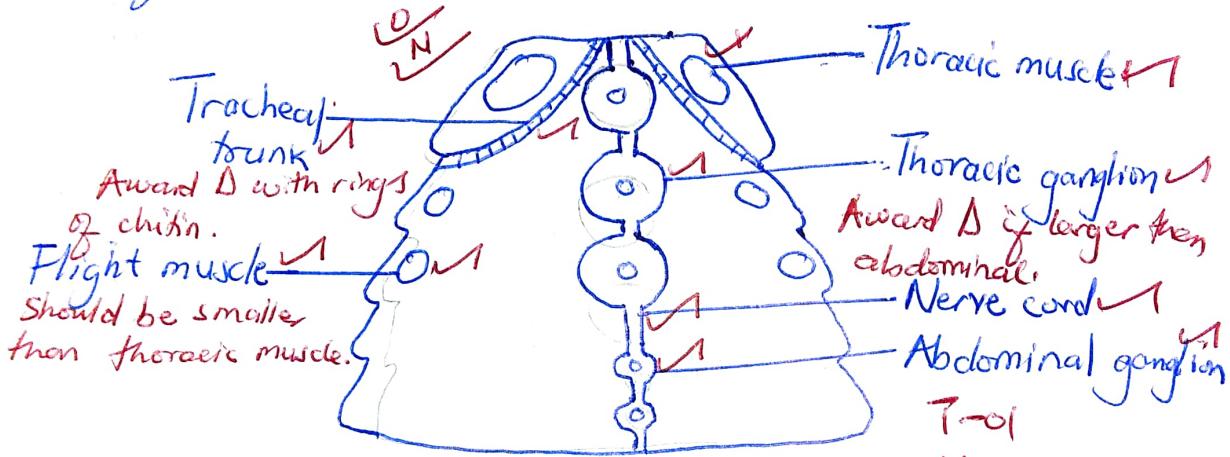
- (e) Dissect further into the thorax to display the internal structures within the thorax on the ventral cuticle. Cut off the alimentary canal.

- (i) Measure and record the length of the ventral cuticle.

..... mm 01 (01 mark)

- (ii) Draw and label all the internal structures that remain attached in the anterior half of the ventral cuticle. (8½ marks)

A drawing of the internal structures attached to the anterior half of the ventral cuticle/sternum of specimen Z/Cockroach. ✓



, Acc. one extra abdominal segment. X2 - 5 ✓

, Ignore salivary glands.

, NADL - If alimental canal draw and any dorsal cuticle structure drawn and labelled.

10 marks

- (iii) Explain the significance of the structures observed in (c) (ii) in the _____ 11

- Large/thick thoracic/flight muscles for increased flapping/movement of wings. ✓

- Long nerve cord extends entire length of the body for easy coordination/easy passage transmission of impulses. ✓

- Tracheal trunk has rings of chitin to keep it open for continuous passage of respiratory gases. ✓

42 marks

40 max

NA. (03 marks)

not considered.

You are provided with specimen **P**, solution **Q** and distilled water.

- I. Using a cork borer provided, prepare six solid cylinders from specimen **P**, each with an initial length (IL) of 5 cm long.
- II. Label six test tubes **A**, **B**, **C**, **D**, **E** and **F** and in each, pour a mixture of distilled water and solution **Q** in proportions shown in table 3.
- III. Place one cylinder obtained from specimen **P** in each of the test tubes, ensuring that it is immersed into the solution.
- IV. Leave the test tubes to stand for **one** hour (*meanwhile you may continue with other work*).
- V. After one hour, remove each of the cylinders from the solutions, one at a time and place each on a filter paper. Quickly measure and record the new length (NL) of each cylinder in table 3 and complete the table.

(a) **Table 3** (09 marks)

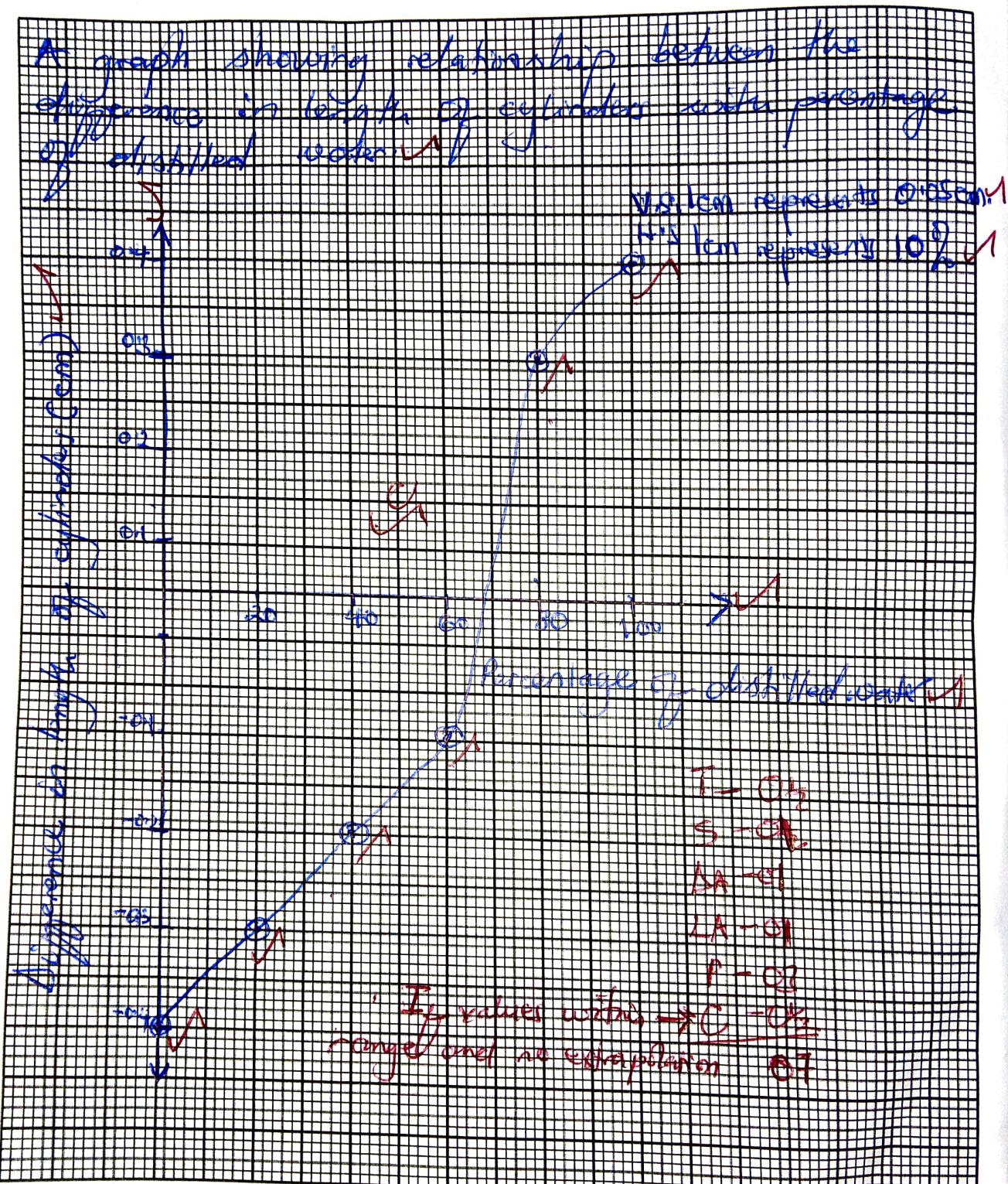
Test tube	Volume of distilled water added (cm ³)	Volume of solution Q added (cm ³)	Length after one hour (NL) (cm)	Difference in length $\Delta L = NL - IL$ (cm)	Percentage of distilled water added
A	10	0	5.2 - 5.4 ✓	0.4 ✓	100 ✓
B	8	2	5.1 - 5.3 ✓	0.3 ✓	80 ✓
C	6	4	4.8 - 4.9 ✓	-0.1 ✓	60 ✓
D	4	6	4.6 - 4.8 ✓	-0.2 ✓	40 ✓
E	2	8	4.5 - 4.7 ✓	-0.3 ✓	20 ✓
F	0	10	4.4 - 4.6 ✓	-0.4 ✓	0 ✓

Rej: IL-NL used

Reject measurements outside range but award graph with C6.

09 marks

- (b) (i) Plot a suitable graph to show the relationship between the difference in length with percentage of distilled water added. (06 marks)



Reject bar graph. T-0%

07 marks

S-0%
DA-0%
LA-0%
P-0%
C-0%
07

- (ii) Using the graph, determine the percentage of solution Q by volume, with the same concentration as the cell sap of specimen P. Explain your answer. (05 marks)

from graph
 $100 - 68 = 22\%$ ✓ of solution Q. This concentration of solution Q causes no change in length of the cylinder implying there was no net change movement of water between solution Q and cell sap of cylinder cells by osmosis

05 marks

- (iii) Explain your graph in (b) (i). (06 marks)

Between 0 to 67% volume of distilled water, cylinders reduced in length/there was negative change in cylinder length implying the solutions were hypertonic/more concentrated/had low osmotic (solute) potential/lower water potential/higher pressure osmotic pressure than the cell sap of cylinder cells. cylinders lost water to the solution by osmosis cylinder cells become plasmolysed/placcid resulting into decrease in cylinder length.

Between 69 to 100% volume of distilled water, the cylinders increased in length/there was a positive change in cylinder length implying the solutions were hypotonic/dilute/less concentrated/had higher solute potential than cell sap of cylinder cells cylinders gained water from the solutions by osmosis resulting into increased rigidity of the cells hence the cylinders increased in length.

Turn Over

10± marks

- (c) (i) Explain why the new length of the cylinder in test tube A could not go beyond the length you have recorded in table 3.
(1 hour is sufficient for the physiological process being investigated in this experiment.) (05 marks)

The cells can't elongate/expand any further hence have reached their full turgor. The rigid/inelastic/firm/tough cell wall has developed pressure potential/wall pressure to prevent further expansion of the cells by net gain/intake/absorption of water.

05 marks

- (ii) Explain the ecological significance of the experimental results in the plant from which specimen P was obtained, if the soil solution is 37% water. (04 marks)

Soil solution would be hypertonic to the cell sap, the plant cells would lose water by osmosis and become plasmolysed resulting into stomatal closure/wilting and thus reducing the rate of transpiration/rate of water loss through transpiration.

04 marks

35 $\frac{1}{2}$ marks

8 (35 marks)

09 marks

3. You are provided with specimens; H, I and J.

(a) Using a hand lens, describe the

(i) arrangement of the florets of specimen J.

(02 marks)

Each floret arises from the axis of a bract. Numerous, sessile/non-pedicellate/unstalined florets arranged radially/ring form/circular/concentric at the clubbed/expended apex/end/tip of the long peduncle axis with young florets at the centre and older at the periphery.

(ii) structure of the essential parts of a floret of specimen I. (05 marks)

03 max

Pistil is monocarpous/single carpelled with superior elongated ovary. Short thin style attached to a spear shaped elongated hairy stigma. 8 free stamens with long stenile/thin filaments attached to round small bilobed anthers.

06 max

(b) (i) Explain the significance of the arrangement of florets of specimen J. (04 marks)

Numerous florets make it conspicuous to insect pollinators thereby increasing chances of pollination.

OR Each floret arises from the axis of a bract for protection from mechanical damage.

02 max

110 marks

- (ii) State the differences between the gynoecium of the florets of specimen J and specimen I.

Any 3.

(03 marks)

J	I
<i>ace hairy</i> , smooth stigma.	hairy stigma ✓
hook shaped stigma	spear shaped stigma ✓
shorter stigma	longer stigma ✓
shorter ovary	longer ovary ✓
round ovary	elongated ovary ✓
longer style	shorter style ✓

- (c) (i) Rub the anther of specimen I on the glass slide and observe the slide under medium power of a light microscope. Describe what you have observed.

(1½ marks)

Small ✓ circular/round ✓ rough surface/
wrinkled/crenated pollen grains. *0 1/2 marks.*

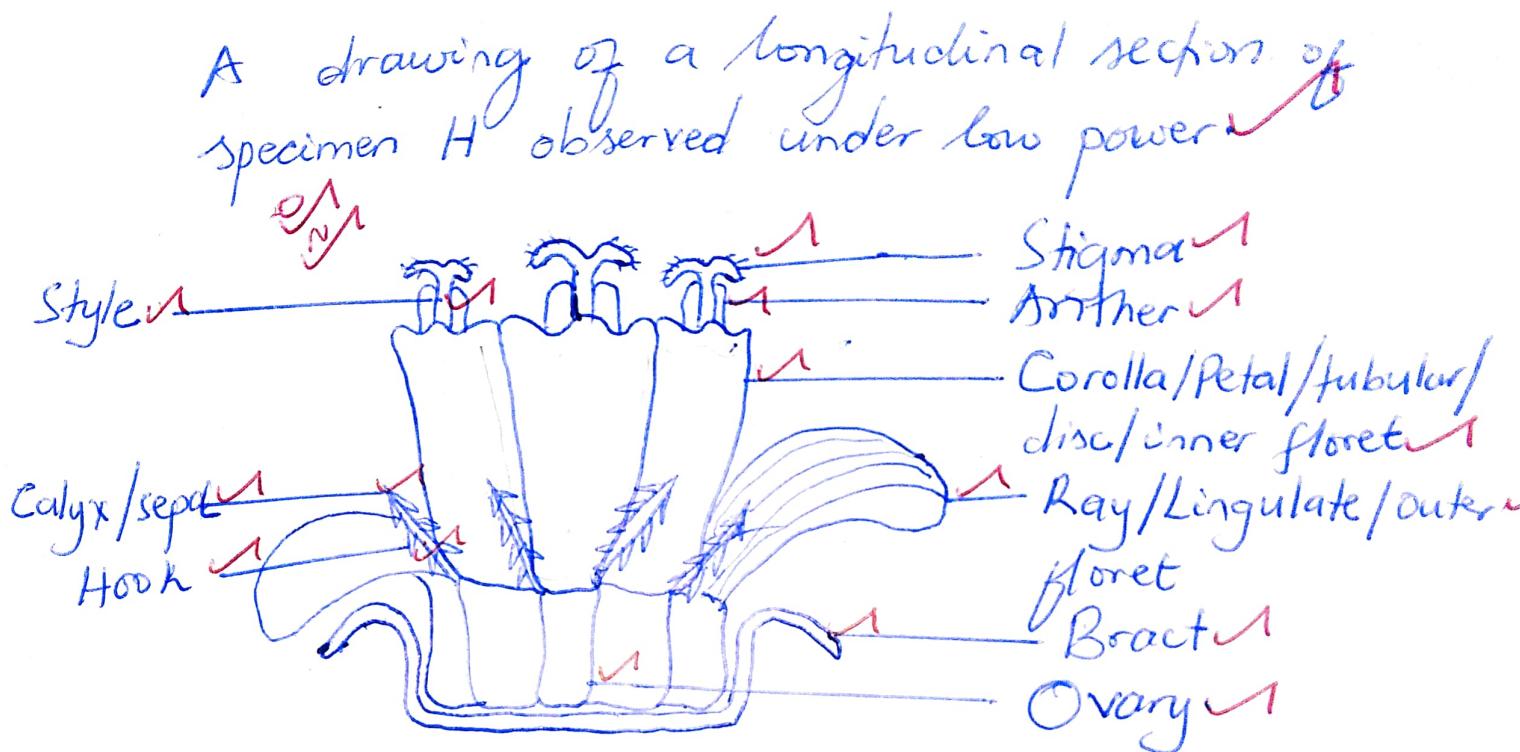
- (ii) From your observation in (c) (i), state the mode of pollination of the florets of specimen I. Give reasons for your answer.

(03 marks)

Insect pollinated ✓ because the pollen grains have rough surfaces ✓ to easily stick onto the insect's body/hairy surface! *0 3 marks.*

0 7½ marks

- (d) Using a sharp blade, cut off the peduncle of specimen H. Cut the remaining part longitudinally. Slice a thin section longitudinally along the same plane from one half. Observe the slice under low power of a light microscope. Draw and label. (5½ marks)



×30-100 ✓

T-0₂¹
M-0₂¹
D-0₂¹
N-0₂¹
D-0₂₂²
L-0₂₂²

07

25½ mark

25 max