SOLUTION TO UACE UNEB BIOLOGY PAPER 3

PASTPAPERS (1992-2016) AND REVISION NOTES

'A' LEVEL BIOLOGY PRACTICAL

PREFACE

This practical book has been compiled by ROBERT BANDIKUBI to improve practical answering techniques of students preparing for A-level Biology Practical (P530/3) examination at Uganda Advanced Certificate of Education.
This book contains exhaustive practical explanatory notes that equip students with practical skills of critical thinking like observation, drawing, recording of data, critical analysis, assessment and interpretation of data.
Questions and answers in this book are to guide students specifically on question approach that will improve on their answering technique that is supposed to be precise and exact.

It also contains well organized practical questions on dissection for practice, based on UNEB syllabus, hence offers extensive practice in all areas of dissection Practical Biology.

This book is expected to improve on their Knowledge, attitude, practices and confidence, hence enabling the students excel in A-level Biology Practical (P530/3) examinations.

"A" LEVEL BIOLOGY PRACTICAL REVISION NOTES AND UACE BIOLOGY PAPER 3 PAST PAPERS (P530/3)

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GUIDELINES TO DISSECTIONS

The main objective of dissection is to study anatomy of organisms. This involves studying of the location, structure and functions of each organ of various body systems of an organism. For example, organs of digestion, organs of reproduction, organs of excretion, organs of nervous system, and endocrine organs, then make a drawing basing strictly on the instructions of the question.

THE FOLLOWING RULES SHOULD BE ADHERED TO WHEN CARRYING OUT A DISSECTION.

- **Read the instructions carefully right to the end, then carry out the tasks reading instructions again, item by item.**
- **Always have with you a complete dissecting kit.**
- **Ensure the animal is dead before you proceed to dissect.**
- **Pin the animal on board or on the hard button of a dissecting dish with the body well stretched.**
- **When dissecting long thin structures like nerves, blood vessels, intestines etc. Cut along them but not across their length.**
- **Always keep the organs of specimen wet using moist cloth or cotton wool.**
- **Never cut or remove anything without knowing what it is.**
- **If the animal has a lot of fat, remove it to expose underlying organs without injuring other organs.**
- **The magnification should be indicated at the left bottom of the drawing.**
- **Make sure you display the structures instructed in the question clearly.**
- **All drawings of dissections should be large, well labeled without label lines crossing each other.**
- **Never allow bleeding of the animal, if it does wipe it thoroughly with wet cotton wool.**

THE COCKROACH

CLASSIFICATION OF THE COCKROACH

Kingdom:	**Phylum**	**Class**	**Order**
Animalia	Arthropoda	Insecta	Dictyoptera
Family	**Genus**	**Species**	
Blattidae	Periplaneta	periplaneta americana, (Africana	

The phylum of a cockroach is an **ARTHROPODA** due to the

- possession of exoskeleton –for protection and locomotion
- segmented body- for flexibility
- Jointed appendages like limbs,-for flexibility.

Its class is **INSECTA** due to

- the possession of three main body parts(head, thorax and abdomen),
- three pairs of limbs,
- a pair of antennae, and
- three thoracic segments (prothorax ,mesothorax and metathorax)

Its order is **DICTYOPTERA** due to

- the possession of long segmented, tapering antennae
- dorso-ventrally flattened body,
- A pair of segmented anal cerci.

SHAPE AND APPEARANCE OF THE BODY;

Shape:
The body is dorso-ventrally flattened and its abdomen is expanded in the middle.
The significance of flattened body to easily enter narrow places /cracks or crevices to escape predation.

Appearance:
The animal is pale brown in colour on the dorsal surface beneath the wings, and dark brown on the ventral surface, its exoskeleton is waxy and glossy (smooth), the significance of the brown colour is for camouflage in order to escape predation. The waxy nature of its body surface prevents desiccation, as it is water repellent ,the glossy exoskeleton is for easy escape from the enemies.

HABITAT AND HABITS:-
Habitat:

Dark cracks and crevices of wall especially in the vicinity of warm places

Habits: they are nocturnal, emerging to feed only at night .they feed on a variety of organic materials including household property like paper and cloth .cockroach run very fast and they can fly due their long hind limbs.

Adaptation of the cockroach to its environment:

- Body is dorso-ventrally flattened to enable it enter into small cracks to avoid predation.
- The sharp hard curved claws and arolium ensure firm grip on rough and smooth structures respectively.
- Their dark brown colour is for camouflage hence reducing chances of predation
- The long antennae for detecting stimuli at a distance and in all directions respectively.
- Mandibles are hard, sharp and serrated to cut food
- The body cuticle is waxy, preventing desiccation of the animal
- The pointed spines on the limbs for protection and movement on rough surfaces.
- The hind legs are long for fast movement.
- The broad/large membranous inner wings for easy flight.
- The thicker outer wings for protection against physical injuries.
- The segmented body for increased flexibility during locomotion.
- The large compound eyes for increased surface area for sensitivity to sight.

THE BODY AND MOUTH PARTS

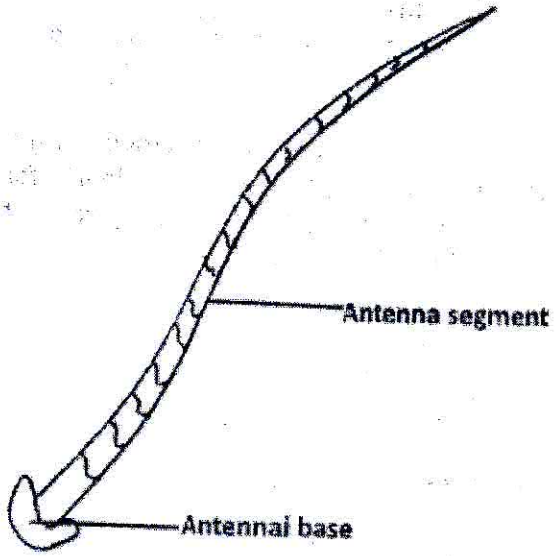
THE HEAD

The head is small and clearly viewed from the ventral side .it is separated from the thorax by a short neck and limited in movement posteriorly by an enlarged tergum of prothorax.

It has **compound eyes** which are in meshes of ommatidia/netted, large, kidney shaped, black in colour and are situated dorso-laterally at the end .the location of the eyes gives the animal a wide field of view in its habitat. The eyes are enlarged to increase the surface area for receiving light .the black colour of the eyes increases the ability of the eyes to absorb light for easy seeing.

Compound eyes; *are Large/protruding/curved outwards for wide field of view*

Drawing showing the antenna of a cockroach



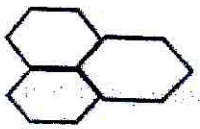
Describe the arrangement of the eye units

It *consists of hexagonal/polygonal;large;numerous;;closely packed;;ommatidia which are adjacent to each other;;regularly/parallel;;arranged*

Significance of the arrangement

Numerous ommatidia/units/compact regularly arranged to increase field of view and sensitivity.

Drawing of the three eye units



X300

The head bears one pair of antennae which is characterized by having a broad base being hairy, thin, and long to the length of the whole body, segmented, and tapers from base towards the tip.

Adaptation of the antennae to their function

- Long to feel/sense at long distance/a distance around the body.
- Segmented /jointed for flexibility/to ease movement
- Thin/slender to easy swinging in all directions
- Antennae segmental/jointed for flexibility/easy swinging/more in all direction
- Tapering antennae to easily swing in all directions
- ❖ It has socket at the base for increased flexibility
- ❖ They are hairy to increase sensitivity.(microscopic)

NOTE:

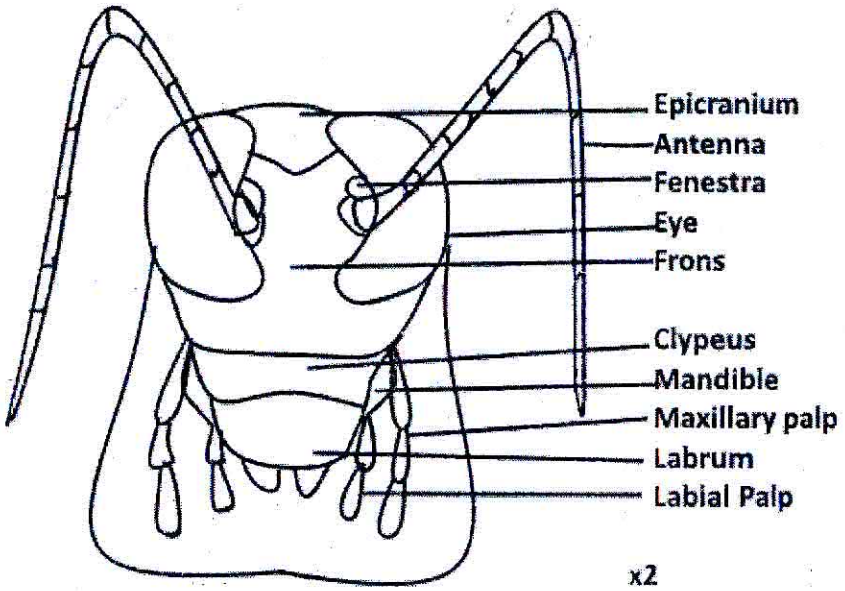
Segmentation of the antennae at the base is even for females and uneven for males .The anterior end of the male cockroach is pointed while that of the female is blunt.

When the head is viewed from the dorsal side, the base of the antennae and their first segments are not observed, but the kidney shaped black compound eyes are observed clearly.

Note

When the specimens are viewed from the dorsal side, the sides of the specimen match with those of the observer. In other wards; the right side of the specimen is on the right side of the observer.

Drawing of the ventral view of the HEAD of the cockroach



When the head is viewed from the ventral side of the animal, the base of the antennae is observed with their first segments covering parts of the compound eye.

MOUTH PARTS

These are the labrum upper lips.

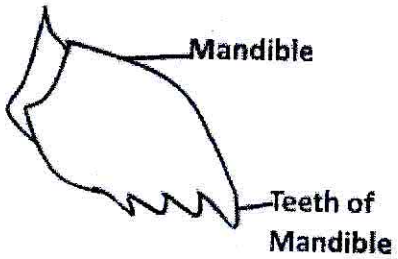
- One pair of mandibles and maxillae.(1st maxillae)
- Labrum lower lip (2nd maxillae)
- Hypopharynx.

The labrum (upper lip); the upper lip which covers the other mouth parts.

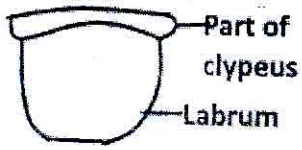
The mandibles: they are two in each animal .they are hard, attached to the body by tough muscle, and have toothed sharp edge

***Mandibles** are Serrated/toothed edge to increase surface area for crushing food*

Drawin showing the mandible



Labrum of a cockroach using a microscope



Labrum/upper lip is curved to prevent food from falling out of the mouth during feeding

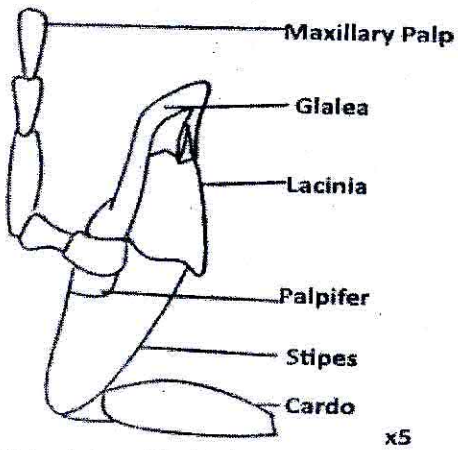
Maxillae

These occur immediately behind the mandibles and consist of hairy ,segmented and long maxillary palps .it also consists of sharp edge ,hooked galea and lacinia ,cardo and stipes .its function is to sense hold and push the food into the mouth ,

The Maxillae is adapted to its function by having;

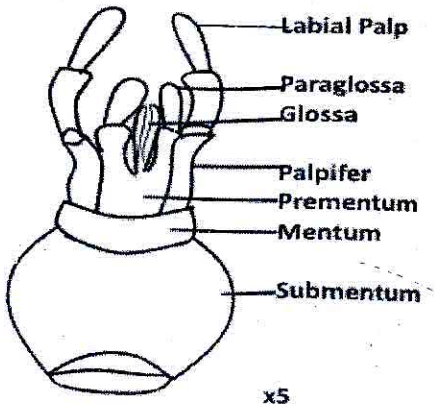
- Have Long palps to reach food at a distance
- Has segmented palps for flexibility/to push food into the mouth.
- Hairy maxillary palps for sensitivity(microscopic)
- Having the lacinia and galea are hooked for holding food.
- Having lacinia has sharp edges for cutting food.

Drawing of Maxilla



x5

Drawing of the Labium



x5

Labium

This is made up of three proximal segments called submentum, mentum, palpiger, grossa and paraglossa.

It is used to sense, holds, cut and pushing food into the mouth;

It is adapted to its function by;

- Having hairy labial palps to increase sensitivity to food.
- Has segmented palps for flexibility/to push food into the mouth.
- Having sharp glossa for cutting food.

THE THORAX AND ABDOMEN

THE THORAX:

The thorax is divided into three segments, the prothorax, mesothorax, and metathorax, in that order from anterior to posterior, each bearing a pair of limbs.

Each limb consists of coxa which is broad, muscular and flattened, the small triangular trochanter, a long and muscular femur, tibia and a distal foot consisting of five jointed tarsus of varying length which reduces downwards.

HIND LIMBS

The **foot** bears pointed spines for protection and firm gripping onto rough surface.

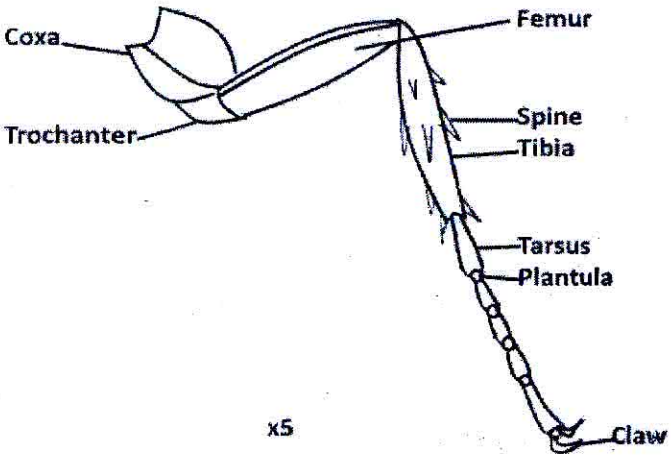
It is jointed for increased flexibility.

Each of the first four segments bears sticky pad called plantulae for easy moving on slippery surface. The last foot segment bears **arolium** located between the curved claws.

The glandular pad called arolium is enlarged to provide a large area for attachment /gripping on the slippery surface. It has glandular pads on tarsal segments for secreting a sticky substance for gripping on slippery surfaces during locomotion.

The **claws** are long, curved, pointed and tapering. Claws are hard and curved easy attachment on rough surfaces and defense. The spines are long, pointed, and curved inwards; the spines are long and pointed for easy defense by pricking the enemy.

Drawing showing structures of the Hind leg of a cockroach



Adaptation of the Hind limbs

- *Jointed for flexibility*
- *Pointed spines for defence/protection against enemies*
- *Pointed spines to increase grip on rough surfaces*
- *Pointed/curved claws for grip on rough surfaces*
- *Plantulae/arolium/glandular pad for secretion of adhesive/sticky substance for grip on slippery/smooth surfaces.*
- *Dull coloured for camouflage*
- *Broad/large coxae for generation of propulsive force/for locomotion*
- *Long femur/tibia to generate propulsive force/for locomotion/movement*

WINGS

Two pairs of wings arising **from** mesothorax and metathorax
The **forewings /outer wings** arise from mesothorax

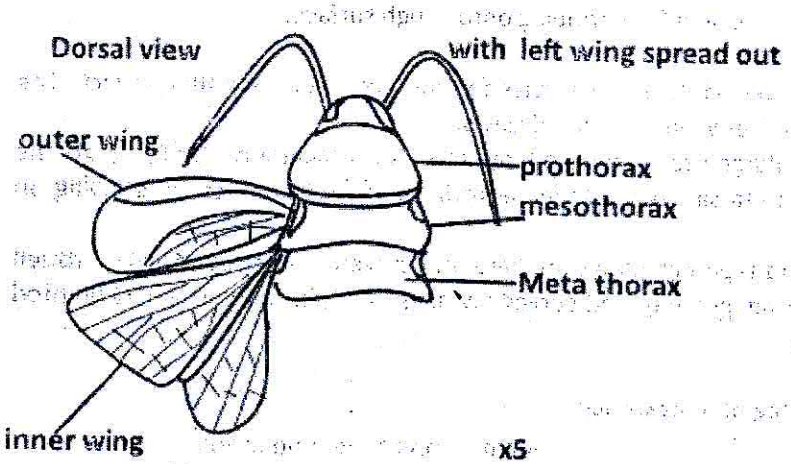
Description

***Straight, elongated**/oblong, **narrow,** relatively **thick,** and mainly parallel **veined** to form tegmina to offer protection.*
The highly thickened forewings of insects like beetles are called Elytra (singular Elytron) due to their position and are also for protection

Hind wings

The **hind wings /inner wings** (flying wings arise from metathorax and are
Description

Membranous/thin, broad, notched margin; folded and supported by a branching network of *veins*. They are used for flight. Wings arise between the tergum (dorsal cuticle) and pleuron. (lateral cuticle)
The inner wings have three main veins also allow circulating of air hence making the wings light for flight.



NB:
The wide spread of the veins provides enough support and large surface area for circulation of gases.
Two pairs of spiracles exist on the thorax between the prothorax and mesothorax and the other between mesothorax and metathorax.

Differences between thoracic and abdominal spiracles

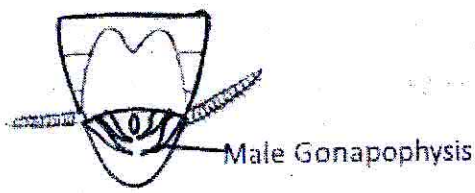
Thoracic spiracles/	abdominal spiracles
• Relatively Larger	Relatively smaller
• Oval shaped	round
• Has valves	Lacks valves
• Unhairy aperture/smooth	it's hairy

THE ABDOMEN:

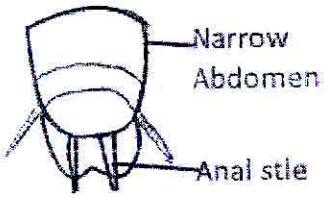
The abdomen consists of ten (10) segments, though not all are visible.
The first seven segments are easily visible in both sexes; the 7th tergum almost completely overlaps the 8th the 9th tergum narrow compared to the 7th .the 10th tergum is flat and broad and notched/divided. from the base of the 10th tergum, a pair of segmented, hairy, tapering and elongated cerci project.

- The abdomen of the male cockroach is narrow compared to that of the females.
- The 9th tergum of the males bares a pair of external genitalia called styles which are absent in the females.
- The female cockroach bears podical plates which are visible on ventral side of the abdomen .the podical plates are missing in the males.
- When the 10th tergum is lifted upwards, **reproductive gonapophyses** structures.
- They are just covered by the 9th and 10th segments in the males, or covered by 10th podical plates in the female.

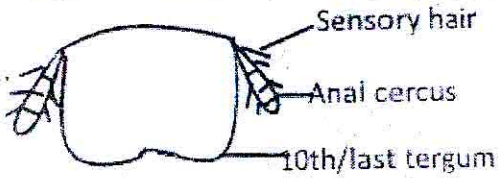
Drawing showing the male Gonapophyses



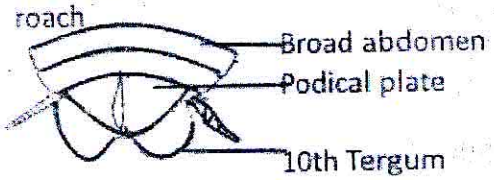
Ventral posterior end of a male cockroach



Drawing of the structures on the ventral side of the las tergum



Ventral posterior end of a female cock roach



From the **dorsal view**, podical plates of the female cockroach are not seen. But however the styles of male cockroach protrude beneath the last abdomen segment.
From the ventral side the attachment of the cerci is not visible .podical plates are seen .The podical plates protect the cacoon .The abdominal end of the female cockroach is broader than that of the male cockroach.

SEX INDENTIFICATION

Sex: Male	Female
• *Has a narrow abdomen*	*Has a broader abdomen.*
• *Has a pair of unsegmented styles*	*Has podical plates/podical opening/ovipositor/ oothecal chamber*
• *Has pointed male gonapophyses*	*has blunt/round ended female gonapophyses*

BODY SYSTEM OF THE COCKROACH

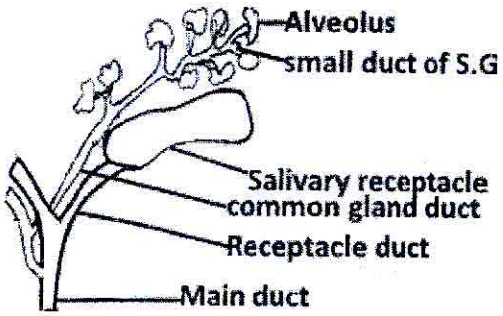
Digestive system .The alimentary canal of a cockroach consists three main regions, the fore gut, short mid gut (**mesenteron**) and hind gut.
Alimentary canal starts from the gullets down to the anus. It consists of gullet, crop, and gizzards, digestive caecum, mid gut, ileum, hind gut (colon) and the anus.

SALIVARY GLAND

It is found in prothoracic region and it consists of salivary receptacle, salivary gland and salivary ducts. Salivary glands are divided into numerous, round and small alveolar shaped secretary parts. The numerous secretary parts increase the surface area for secreting digestive juice (saliva).
The common duct of salivary gland braches into many small ducts which spread allover the salivary gland.

This arrangement increases the surface area for collecting saliva.
The main common duct for receptacle branches into two large ducts .each duct collects the saliva from the salivary receptacle is structurally elongated and large in order to store much saliva .

Drawing of the salivary gland under medium power



Adaptations of salivary gland to its function

- It consists numerous secretary parts (alveoli) to increase surface area for secreting saliva.
- It consists of large salivary receptacle for storing more saliva.
- It consists numerous ducts to easily collect more saliva.
- All ducts fuse into one main ducts to control flow of saliva

THE GULLET

It is tubular and elongated structure .it made up of muscular wall with a smooth inner lining .the longest part of it is found in the thoracic region, the contraction of muscular wall moves the food to the crop .the smooth inner lining eases movement of the food.

THE CROP

The gullet dilates to form the crop .it is found in the abdominal region ,it is enlarged ,conical shaped and consists of elastic muscular wall with smooth folded inner lining and wide lumen. Starch digestion also occurs in the crop by means of salivary amylase produced by salivary glands.
Its function is storage and for preliminary digestion and absorption of food.
The crop is adapted to its function by having;

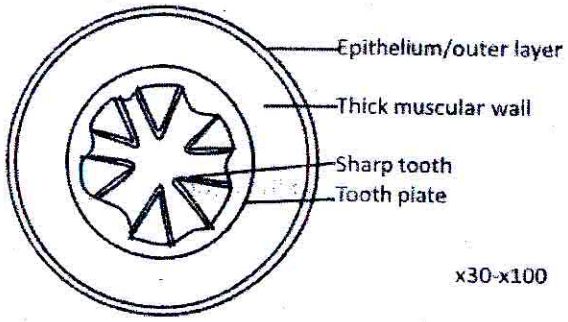
- Folded inner lining is to increase the surface area for digestion of food
- It is Elastic and folded to easily stretch and accommodate /store food.
- Smooth inner lining for easy passage of food.

THE GIZZARD

The gizzard is a short conical chamber with thick muscular walls. Its lumen is narrow and reduced by infoldings of the wall and the six principal folds are highly sclerotized/ hardened thickenings ending in pointed teeth.
Its inner lining is folded and ridged /rough .the gizzard is **adapted to its function** by having.

- Folded inner lining to increase the surface area for digestion of food.
- Toothed /Six ridges for physical/mechanical digestion of the food.
- Thick muscular wall to generate powerful contraction during crushing of the food.

Drawing of a cross section of a gizzard of a cockroach



THE DIGESTIVE (MESENTERIC) CAECUM

These are many/eight, tubular, long, cylindrical, flexible, and anterior tapering structures projecting from the **mid gut**. Their functions are secretion of digestive enzymes for digestion of food and absorption of digested food.
They are many, long and tubular for increasing the surface area for absorption of soluble food.

The mid gut The mid gut starts from just behind the gizzard and ends in front of the ileum. It is a site for digestion and absorption of food.

It is a thin walled long tabular organ attached to the gizzard. It is the place where most of the digestion and absorption of digested food takes place.

Adaptations of the mid gut

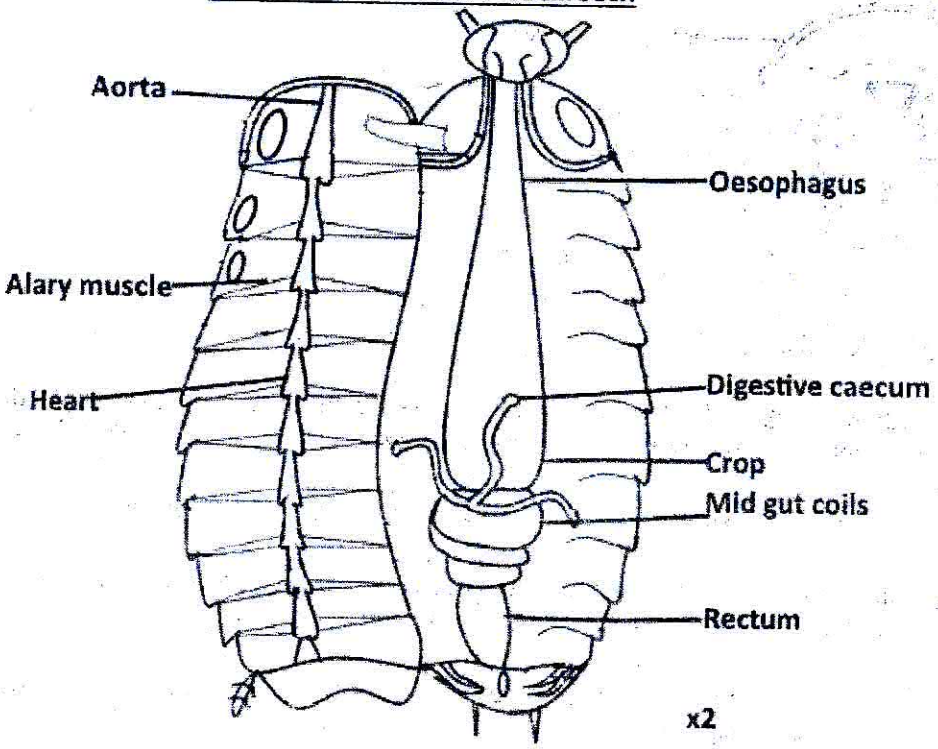
- It has many digestive caeca to increase the surface area for *absorption of soluble food and for* release of digestive juices
- The thin inner wall eases absorption of digested food.
- Lacks cuticle to facilitate absorption of soluble food.

THE HIND GUT

The hindgut consists of **ileum, colon and rectum.**
This part of the gut contains waste materials .there is neither digestion nor absorption of digested food. it is only water absorbed from the colon to increase water conservation .the function of the colon is to allow water absorption and for to passage of wastes .the colon is long to increase surface area for water absorption .it has a large lumen for easy passage of wastes.

THE ILEUM
It is short and thin .it bears numerous thin tubules called malpighian tubules which do not have any digestive function. It is used for removal of excretory waste products. From the haemolymph and empty it into the gut where is removed together with the faeces. It is still used for absorption of digested food

Drawing showing undisplaced Alimentary canal and strutures attached on the dorsal cuticle of a cockroach



ADAPTATIONS OF THE ILEUM

Internally, the ileum is folded longitudinally and possesses many thin backward pointing setae to control passage of undigested food material and uric acid.

It is narrow to allow food stay longer in the mid gut to maximize digestion and absorption.

Malpighian tubules are not part of the alimentary canal; they are just accessory to it (just attached to it without having any digestive function.).

THE COLON

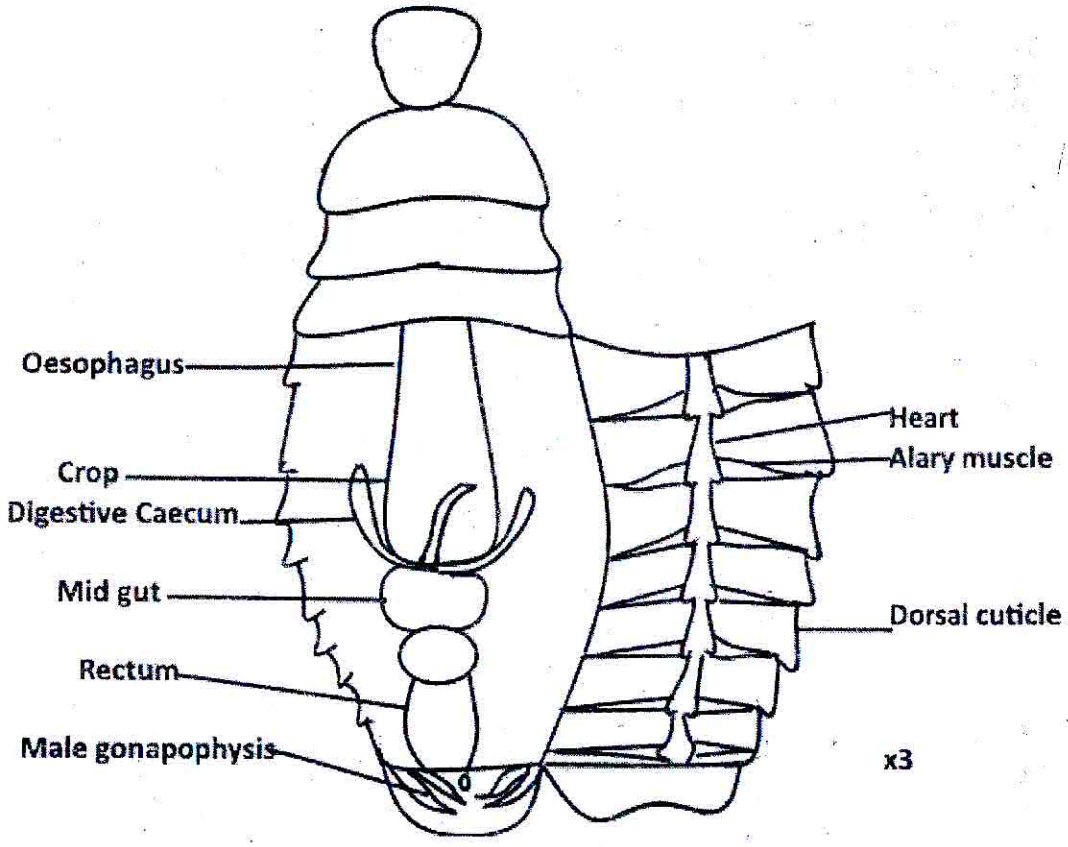
The colon is wider and longer than the ileum and smooth inside.

Adaptation

It is wider and longer to accommodate undigested food and uric acid.

Without any displacement gizzard, hind gut and ileum are not observed. Thus they should not be included in the drawing.

Drawing showing exposed structures in the abdominal region of a cockroach without displacing any organs/structure



THE RECTUM

It stores wastes. Contraction of its wall leads to removal of unwanted materials from the body through the anus.

Is short and wide and has six pronounced longitudinal ridges internally forming the rectal gland.

Adaptation

- It is short and wider lumen to increase storage of the feaces and uric acid temporary.
- It has rectal glands for water absorption.

Generally the hindgut is thicker than fore and mid gut to create powerful peristalsis which aid removal of feaces and solid nitrogenous excreta

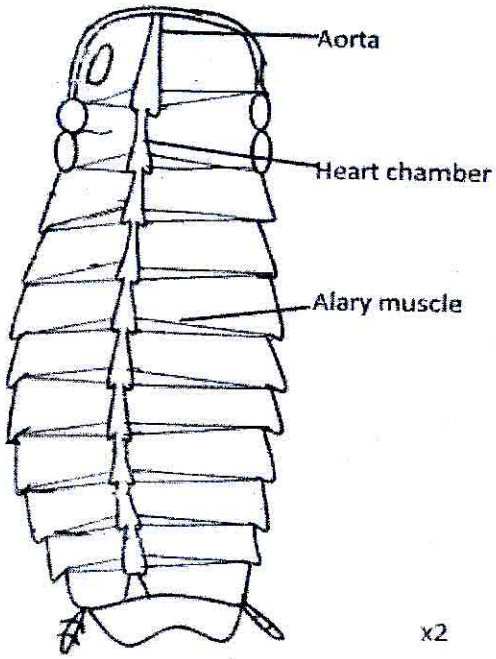
Anus is an external part of the alimentary canal

CIRCULATORY SYSTEM

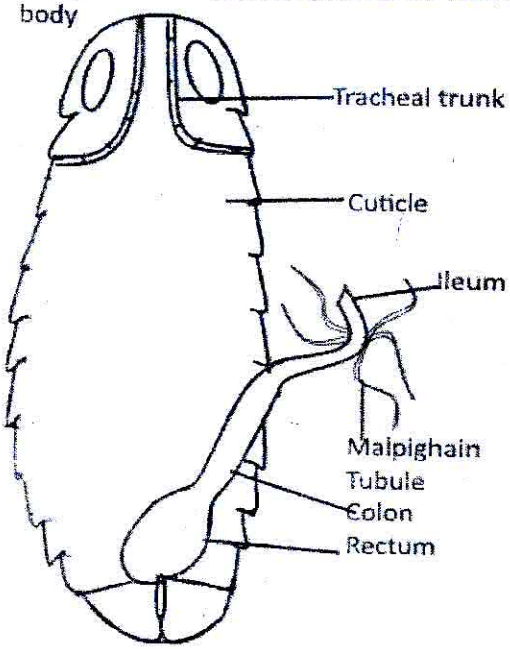
The cockroach has simple open circulatory system made up of the tubular heart, aorta, and the alary muscles. It has thirteen segmental chambers, 10 in the abdomen and 3 in the thorax.

The alary muscles control blood movement through the heart. All those structures are found on the dorsal cuticles.

Drawing sowing circulatory system of a cockroach



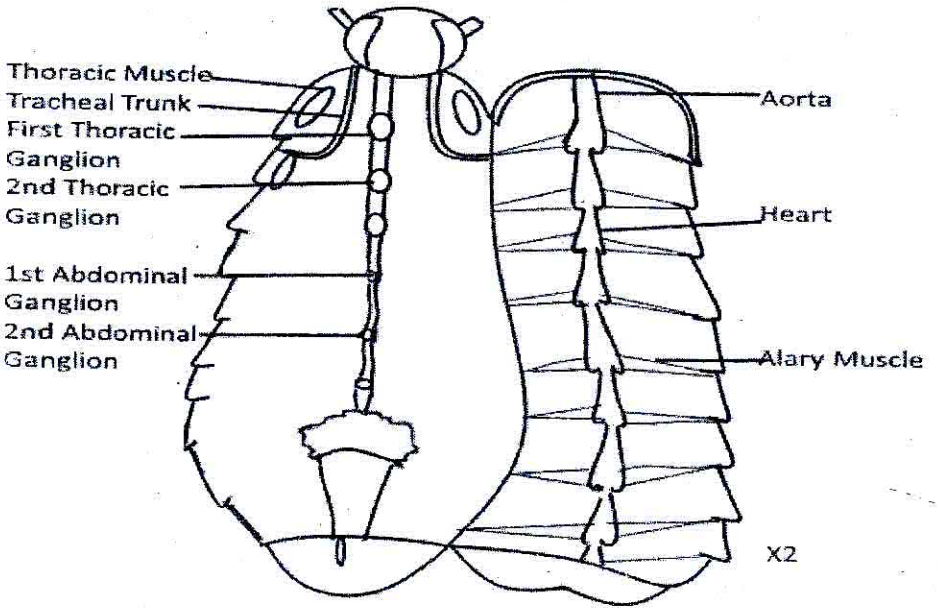
Drawing showing structures for removal of undigested and excretaory materials from the body



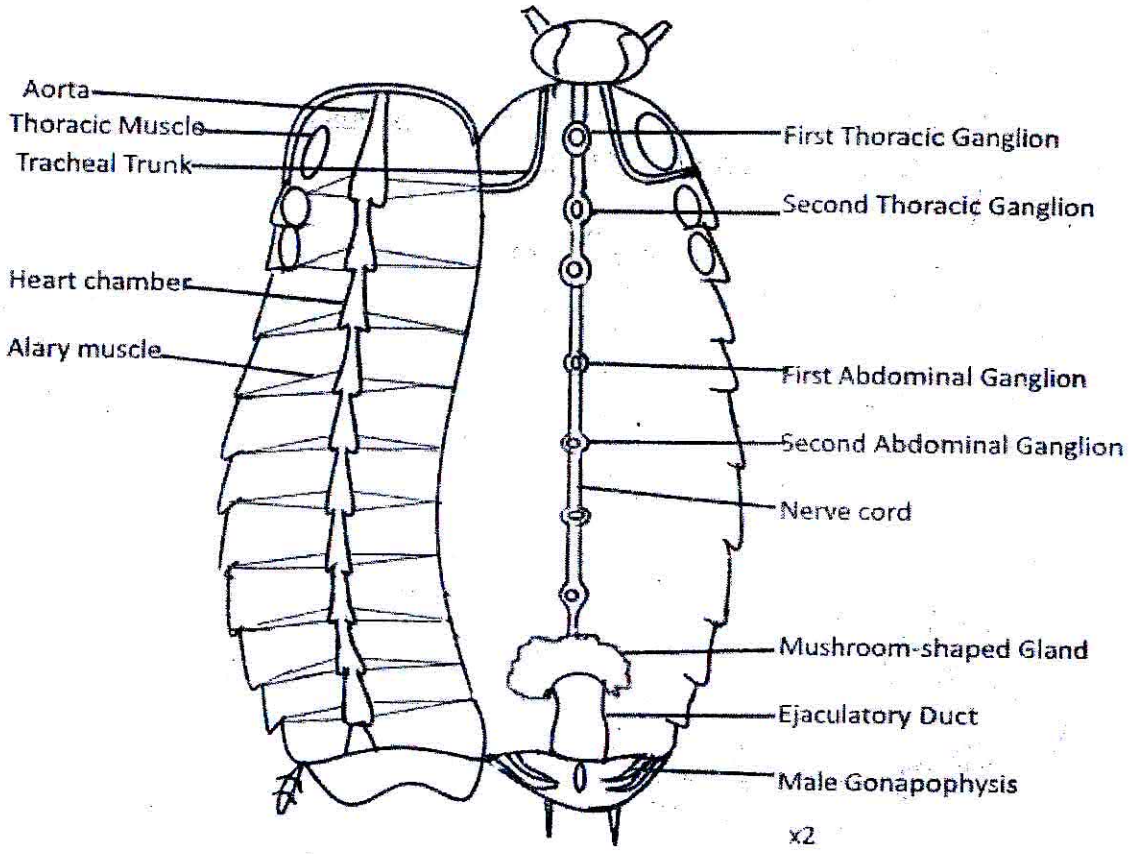
THE NERVOUS SYSTEM

It is the simple system consists of the nerve cord and ganglia .Three ganglia are found in the thoracic region and each segment of the thorax has a large ganglion and there are six abdominal ganglia, the last being larger than others. The nervous system is found on the ventral cuticle.

Drawing of the Non-Buoyant internal structures of specimen P while the Reproductive structures are Intact



Drawing showing structures associated with dorsal cuticle and ventral cuticle after Alimentary canal has been discarded from a cockroach



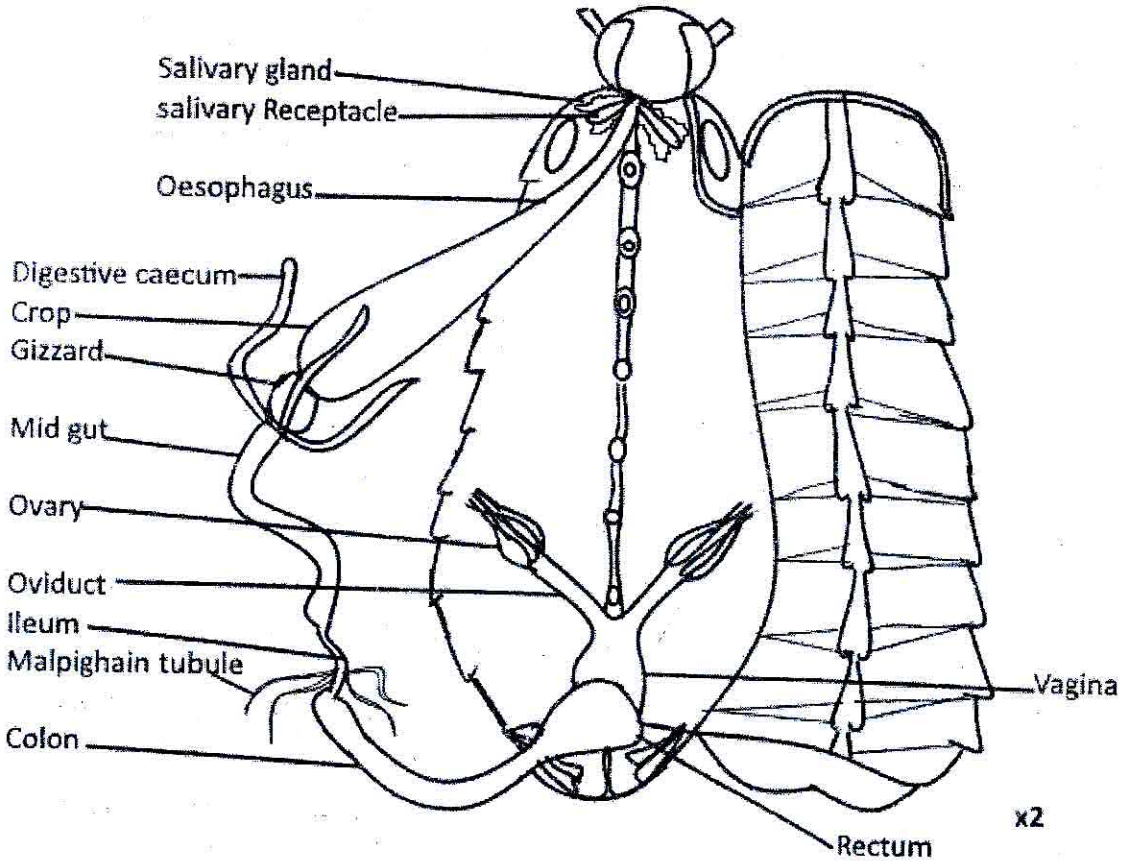
THE REPRODUCTIVE SYSTEM

The male reproductive system consists of the mushroom shaped gland which produces the male gametes, and ejaculatory duct for passage of the gametes.

The female reproductive system consists of the vagina which receives the male gametes, the vagina branches into two oviducts; the left and right oviduct where fertilization takes place each oviduct divides into eight ovaries which produce the ova.

The fertilized ova are wrapped into a cacoon called **oothecal chamber** which is stored and carried by the podical plates. The reproductive system is found on the ventral cuticle.

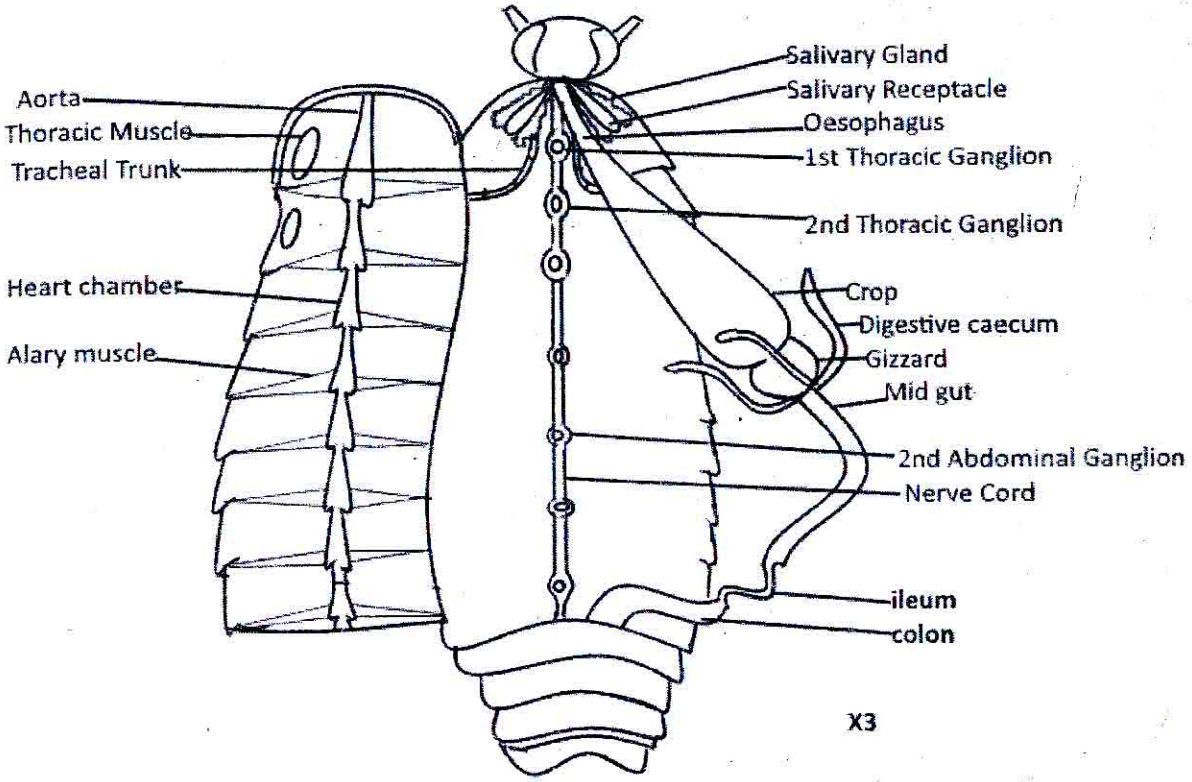
Drawing showing the BUOYANT internal structures with the Alimentary canal displaced to the left of the cockroach



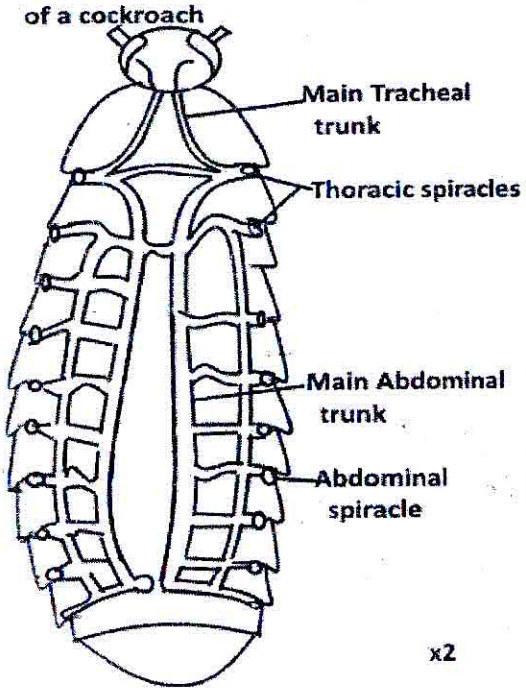
The cuticle may not be fully opened .it is thus necessary to master the location of each and every feature in the cockroach.

This helps to draw correctly incase a part of the cuticles is to be opened. For example the thoracic and the five adjacent abdominal segments can be opened to expose the internal structures as indicated in the drawing below.

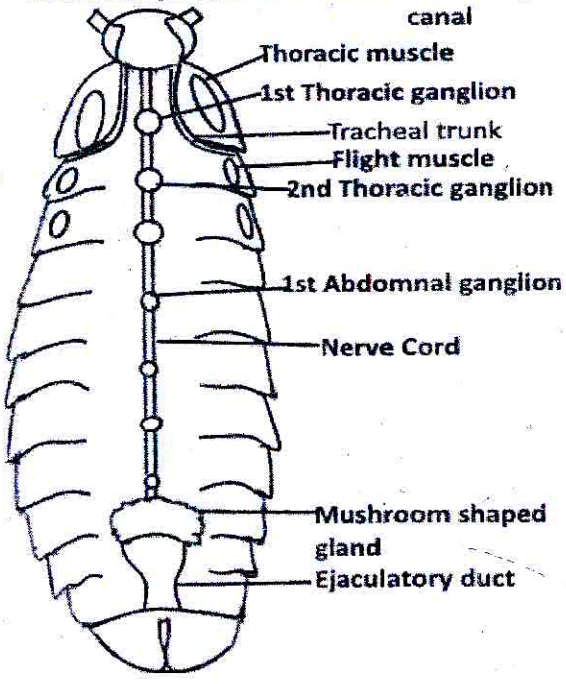
Drawing showing internal structures after opening thoracic region and the five abdominal segments with Alimentary canal displaced to the right side of the specimen



Drawing showing Respiratory system of a cockroach



Drawing of the structures on the ventral cuticle of specimen P without Alimentary canal



AMPHIBIANS (TOAD/ FROGS)

Classification:

Kingdom	**Phylum**	**Class**	**Order**
Animalia	Chordata	Amphibia	Anura
Family	**Genus**	**Species**	
Bufonidae	Bufo	*bufo regularis* (Common toad)	

Reasons for classification in class Amphibia.

- It has a thin moist glandular skin i.e. skin with many mucus secreting glands/warty skin
- It has a wide gape.
- It has a web between the toes/digits of hind limbs.

Reasons for classification in order anura

- It has external eardrum
- Hind limbs are elongated and enlarged for leaping.
- Hind limbs have a web of skin between the digits.

Habitat: Amphibians n land and frequently swimming in fresh water e.g. in ponds or streams.

TOADS

They are usually found in the ponds and moist places of land environment. Thus the habitat of the toads is aquatic and damp land areas.

It is aquatic habitat due to the following reasons.

- It tapers anteriorly to provide a streamlined body to reduce water resistance during swimming.
- Eyes are dorso-laterally l o maintain aerial contact when the body is submerged in water.
- The digits of h b between them to increase the surface area for swimming.
- Nostrils are a located o. he top of the head to maintain breathing when the body is submerged in water.

The habitat is damp terrestrial area due to the following reasons;

- It tapers anteriorly to provide a streamlined body to reduce air resistance during locomotion.
- The eyes are dorsal –laterally located for wide field of view on land.
- The hind limbs are muscular and long for leaping long distance.
- The moist skin for ease cutaneous breathing on land
- Its skin is dark brown/dull coloured for camouflage to escape predation.

N.B Toads and frogs are called amphibians because they have moist skin and webbed toes of hind limbs. However, the toads are more adapted to land than the frogs, only going into water during breeding seasons. On the other hand, most frogs live in water for the rest of their life.

GENERAL ADAPTATIONS OF A TOAD TO SURVIVE IN ITS HABITAT

- *Dorso-laterally positioned/large/round and protruding /bulging eyes for wide vision;*
- *Long/muscular hind limbs for propulsive force/forward thrust when jumping/swimming/locomotion*
- *Head tapering anteriorly/pointed/triangular to provide a streamlined body for reduced resistance during locomotion.*
- *Digits/toes of hind foot have a web between them to increase the surface area for swimming.*
- *It has a wide gape/opening of the buccal cavity for consuming/ ingesting prey of large size.*
- *Small rounded hollow/opening located anteriorly for breathing/passage for gases/air when submerged in water.*
- *Large numerous poison glands for defense/protection/to be unpalatable.*
- *Many mucus secreting glands to moisten skin for gaseous exchange/temperature regulation*
- *Long/muscular hind limbs for propulsive force/forward thrust when jumping/swimming/locomotion*
- *Thin transparent Nictitating membrane to protect the/moisten the eye.*

THE SKIN

- It is thin and moistened by mucus secreting gland to allow gaseous exchange on land and while submerged in water.
- It is warty and slimy making it slippery to touch and hence allowing the animal to escape easily from predation.
- The dull colour (green for frog and dark brown on the dorsal part and pale brown on the ventral part of the toad) helps them to camouflage efficiently in their environment predation.
- It is tough for protection
- It contains poison glands all over the body, with two main ones on the head, for protection against predators.

SKIN ATTACHMENT TO THE BODY

The skin loosely attached to the body wall by loose areolar connective tissue, containing fluid filled large spaces mainly on the ventral abdominal region/ lower trunk region. The loose attachment in the abdominal region is to accommodate lymph sacs which facilitate gaseous exchange.

The skin is firmly attached; to body wall at the pectoral/pelvic region /fore /hind limbs; throat region; on the head to hold the skin on to the body of the animal; and at the limb joints for support during locomotion.

THE NATURE OF THE SKIN

- It is thin to ease diffusion of gases.
- It is moist to ease gaseous exchange by dissolving the respiratory gases
- It has numerous capillaries on inner surface to increase the surface area for gaseous exchange.

Nature and pattern of blood circulation

One; large blood vessel, musculo-cutaneous vein; big sized, emerging from the arm pits branches/divide into smaller blood vessels/venule which subdivide/branch into a network of many blood capillaries; distributed allover inner surface of skin and the blood vessels embedded/attached onto the skin.

SIGNIFICANCE

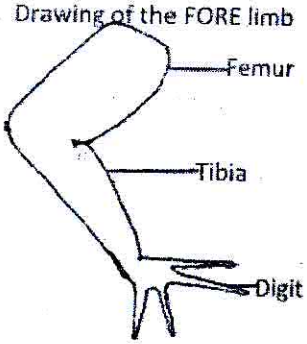
Forms a network to increase the surface area for increased gaseous exchange; and reduced diffusion distance; thus faster rate of materials/ gases; or for increased transport/flow /draining of blood away from the skin; leading to increased gradient/diffusion of gases;

THE LIMBS

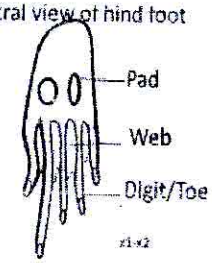
Differences between fore limb and hind limb

Fore limb	Hind limb
• Relatively Short and stout • ends in four well developed digits • No webs between the digits • has two main regions /few joints • smaller and Less muscular	Relatively Long and folded Ends in five well developed digits Has a web of skin between the digits Has three main regions/many joints Larger and More muscular

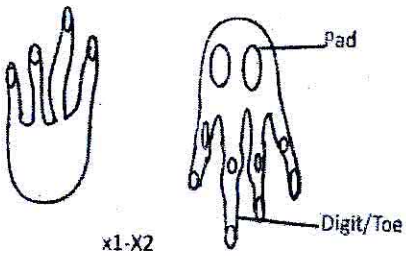
Drawing of the FORE limb



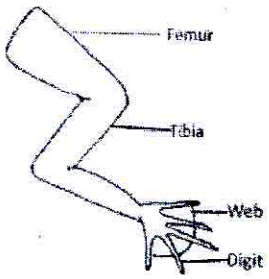
ventral view of hind foot



Drawing of the ventral side of the left foot of a toad

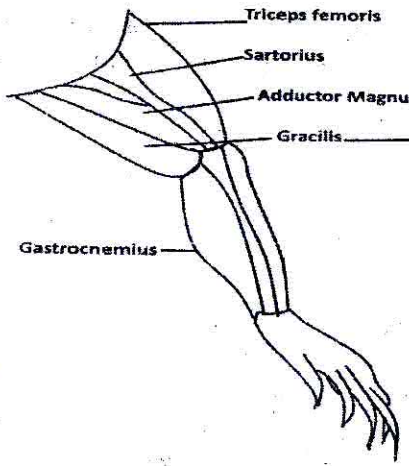


Drawing of the hind limb

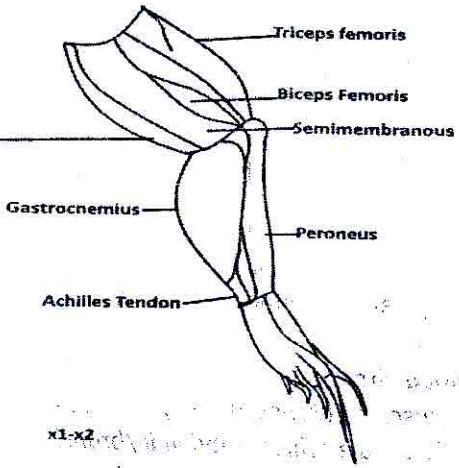


Ratio	Significance
Ratio of fore limb to hind limb is **1:2**	***The hind limb** is twice as long/longer than the fore limb to generate propulsive force for swimming/leaping/hopping/locomotion* ***Fore limb** is shorter/half the length of the hind limb to absorb shock on landing/during hopping/locomotion*

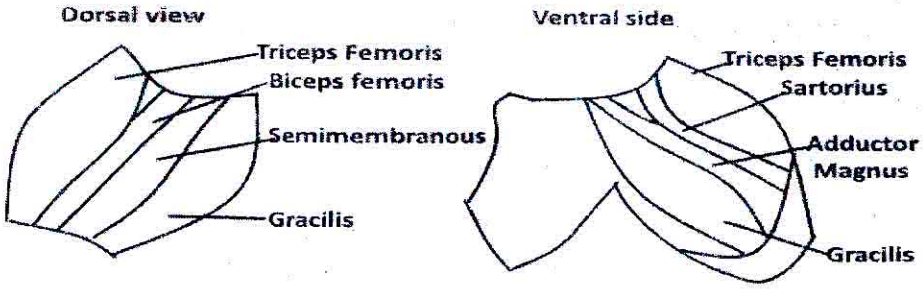
Ventral view of the hind limb



Dorsal vie of the hind limb



Drawing of the muscles of the hind limb observed from he ventral side of atoac



Arrangement of the thigh muscles

Four/five muscle blocks arranged parallel to each other longitudally with large muscle blocks at either the side and narrow blocks in between. Muscle blocks overlap and are closely packed. Muscles attached on either side by tendons.

ADAPTATION OF THE LIMBS TO THEIR FUNCTIONS:

- The fore limbs are short and muscular to absorb the shock on landing; they also support the body off the ground during resting.
- The hind limbs are longer, muscular and highly folded into three regions to provide a great forward thrust to the body during long jumping on land and swimming in water .the length is for long jumping .the muscular nature is for greater thrust force.
- The hind limbs have a web between the digits to provide a large surface area, for easy swimming.
- The hind limbs have longer digits for firm gripping/grasping on land during locomotion.

How Hind limb is adapted for the survival of a toad in its habitat

- *long/muscular to generate propulsive forward thrust for swimming/hopping/locomotion*
- *webbed toes/digits to ease swimming*
- *Jointed digits/limbs for flexibility* during locomotion.
- *dull coloured for camouflage/brown/black patches for camouflage*
- *long digits to increase grip during locomotion*
- *moist skin for gaseous exchange*
- *numerous mucus glands/swellings to secrete mucus to moisten the skin for gaseous exchange*
- *numerous/many poison glands/swellings which secrete poison for defence*
- five well developed digits for support and stability

THE HEAD

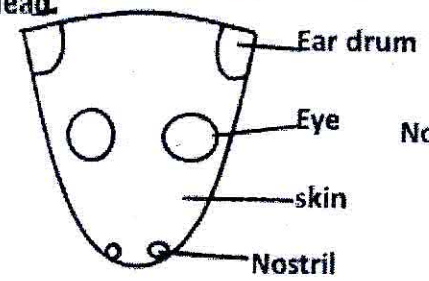
The shape and position

- it tapers anteriorly and triangular with narrow apex and broad posterior and joined to the trunk directly
- It is dorso-ventrally flattened

SIGNIFICANCE OF THE HEAD SHAPE:

- The head tapers anteriorly to give the animal a streamlined body that reduces water and air resistance during movement.
- It's dorsal –laterally flattened for floating.

structures for sensitivity on dorsal side of head



Structures on the left side of the Head

THE HEAD FEATURES

THE NOSTRILS:

- The nostrils are a pair of small rounded opening located anteriorly on the head and above the mouth. This allows smelling and ventilation when the rest of the body is submerged in water.

***Adaptation:** A pair of naris/nares/small holes/nostrils located at the tip of head/snout to ease breathing on land/when submerged in water.**rej** gaseous exchange/help in breathing*

THE EYES:

- The eyes are large, round and protruding /bulging, dorso-laterally located at the head anterior to the each ear drum. They have poorly developed eyelids. The upper one is stiff and immovable while the lower one is modified by developing a third membrane which is thin transparent and movable called **nictitating membrane**.

Adaptation: *Large protruding/dorso-laterally located eyes for wide field of view/better view/clear seeing.*

SIGNIFICANCE OF THE EYES

- The dorso-lateral location of the eyes gives the animal a wide field of view in its habitat.
- The nictitating membrane cleans the eyes and gives added protection without interrupting the continuity of vision

THE EAR-DRUM/TYMPANIC MEMBRANE;

Shape, structure and position

It is prominent, circular, tough and tight/stretched membrane which is laterally located at posterior end of each eye.

Significance of the ear :

- Its tough nature ... es it resist external pressure without rupturing.
- Its being circular gives it a wide surface area for receiving sound waves.
- It is a stretched membrane to easily vibrate upon receiving sound waves to make hearing easy.

***Adaptation**: Flat ear drum/tympanic membrane to allow for streamline shape **or** it's being circular gives it a wide surface area for receiving sound waves and It is a stretched membrane to easily vibrate upon receiving sound waves to make hearing easy.*

THE MOUTH

It is anteriorly located on the head. it has a wide gape for ingesting prey of large size.

It has teeth which are uniform in size and tongue.

Adaptation: *Large mouth to provide a wide gape for capturing/ingesting prey of large size.*

THE TONGUE:

The tongue is long muscular, flat, elastic/ stretchable, forked/bilobed anteriorly, sticky/slimy and has many small blood vessels. It is attached on the floor; at the front.

It is used for trapping insects for food. it has a wide base. On its ventral surface, it has a tributary of lingual vein running in the middle along the tongue. The main vein branches into smaller veins on either side.

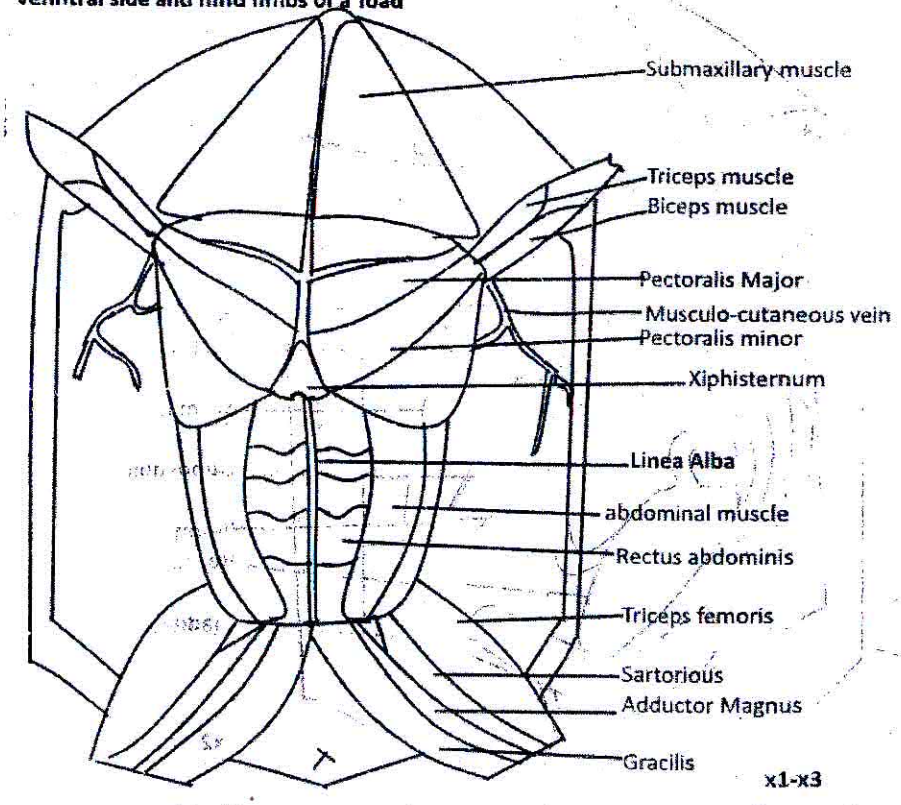
ADAPTATION OF THE TONGUE TO ITS FUNCTION:

- Long and elastic to trap insects at relatively far distance for food.
- Sticky to trap small animals (insects) easily, which are not able to escape once, they fall on it.
- It is muscular to easily stretch out (flick out) and trap insects.
- Flattened to increase the surface area for trapping the prey.
- It has numerous glands that secrete sticky mucus to easily trap the prey.
- It is forked anteriorly to easily trap the prey.
- Has a wide base for firm attachment.
- It is attached to anterior end of the lower buccal floor to easily flick out and trap insect at a long distance.

NOTE

To dissect the toad, lay it on the board with the ventral side upper most. Stretch the limbs and pin them firmly on the board .open and loosen the skin off the underlying body the muscles. Pin the skin to the sides. Take not of the exposed thoracic muscles, **xiphisternum, linea Alba, abdominal** wall, high muscles and cutaneous vessels. The neatly draw and label the dissection.

Drawing showing the main superficial body muscles and muscular arrangment of the venntral side and hind limbs of a Toad



SEX IDENTIFICATION

Distinction between the sexes is not very obvious since there are no external genitalia. However, males and females can be distinguished by following characteristics.

Characteristics of males:

- Usually slender-bodied
- Skin underlying the throat is usually white.
- Develop a rough black, warty patch on the ventral surface of the first (pre-axial) finger on the forelimb called the nuptial pad.

CHARACTERISTICS OF FEMALES:

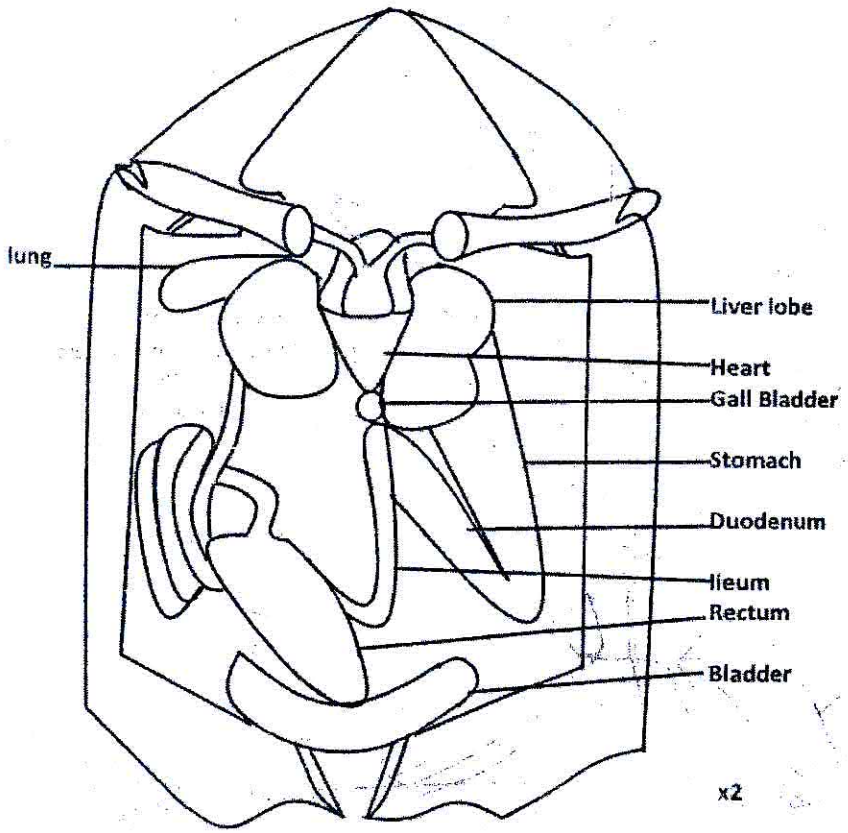
- Broad abdomen, bloated with eggs especially during the breeding season.
- Skin underlying the throat is creamy white /grey.

NB. Don't write no nuptial pad on first finger even when it is true that it is absent except when you are comparing the two specimens.

THE DIGESTIVE SYSTEM:

It is divided into two parts, the alimentary canal and associated organs. The alimentary canal starts from the gullet up to the anus. The associated organs involved any structures that functionary help the alimentary canal to digest and absorb the digested food like the pancreas, liver and the gall bladder.

Drawing of the visceral structures that are found between the fore limb and hind limb in undisturbed state of the Toad



NB: From the drawing above **the stomach and duodenum** are found on the left side of the abdomen. Other organs found on the left side but not visible without displacement are spleen, left kidney, left testis/ovary urethra, ovisac/vesicular seminalis and oviduct.

MOUTH AND BUCCAL CAVITY

The mouth is terminal and very wide, extending back as far as the tympanic membrane on each side. This provides a wide gape for the ingestion of large pieces of food material.

The upper jaw bears a row of numerous maxillary teeth which are structurally uniform, small, pointed, conical shaped and curved inwards.

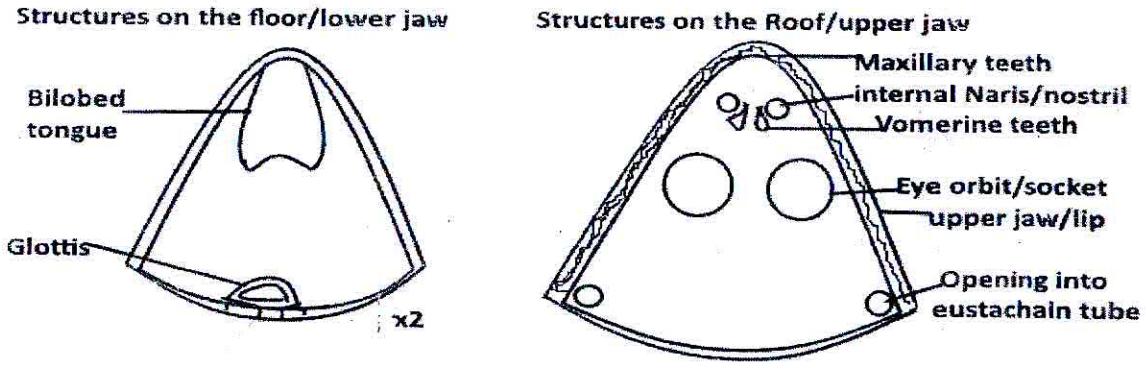
The upper floor bears pores called internal nares (singular; naris) .they are two small round openings, guarded by valves, through which air enters the buccal cavity .each is found on the sides of vomerine teeth.

The vomerine teeth protrude out of the roof of the mouth above the eye balls and between the internal nares .They are many /crowded, pointed, and curved inward, their function is to prevent escape of prey.

The buccal cavity consists of strong jaws which grip the large prey to prevent it from escaping.

Two large oval protrusions on the roof indicate the positions of eyeballs, which play part in swallowing.

Drawing showing the internal structures of the buccal cavity



Maxillary teeth: *feel rough this is to hold prey/prevent prey escape/ready to be swallowed*

Tongue

- *Long tongue to reach out to the prey a distance from the body;*
- *Elastic/flexible to be easily flicked out and stretched into mouth with prey to swallow*
- *Sticky to trap prey and prevent it to get loose; attached to anterior tip of the lower jaw so easily flicked out/to reach out far from the body*

THE ALIMENTARY CANAL

Parts of alimentary canal and their characteristics

THE OESOPHAGUS

This is a narrow tubular long structure with thin elastic wall; its inner lining is smooth and ciliated for easy swallowing of food.

Adaptations of gullet to its function

- It has smooth inner lining for easy passage of food materials.
- It has thin and elastic walls to extend easily to allow passage of large prey.

- It has narrow lumen for easy swallowing of food.

STOMACH:

- It is elongated and thin walled
- Internally, it is folded longitudinally, both to allow distention and increase the surface area for secretion of gastric juice /digestion.
- Posteriorly, a slight constriction indicates the position of the pyloric sphincter and marks the end of the stomach. This controls the exit of food from the stomach.
- Anteriorly, the constriction that controls the entry of food into the stomach is called a cardiac sphincter.

THE ILEUM

It is very long, coiled, narrow, and tubular and made up of thin walls. It has numerous blood capillaries which is a branch of hepatic portal vein .ileum is used for digestion and absorption of digested food. It is adapted to its function by having;

- Narrow lumen for easy absorption by reducing diffusion distance.
- Numerous capillaries to increase the surface area for absorption of digested food.
- Thin wall to easy absorption of digested food.
- Coiled and long tube to increase the surface area for digestion and absorption of digested food.

THE RECTUM

It is a short, thick walled, enlarged and wide tubular organ found between the colon and the cloaca; it is used for storage of wastes /faeces/unwanted materials prior to elimination .contraction of its walls causes egestion of the wastes.

THE HEAD and THORACIC REGION

The toad lacks the neck. Thus there is no clear cut line between the thoracic and the head regions. However the head region starts from the jaws upwards.

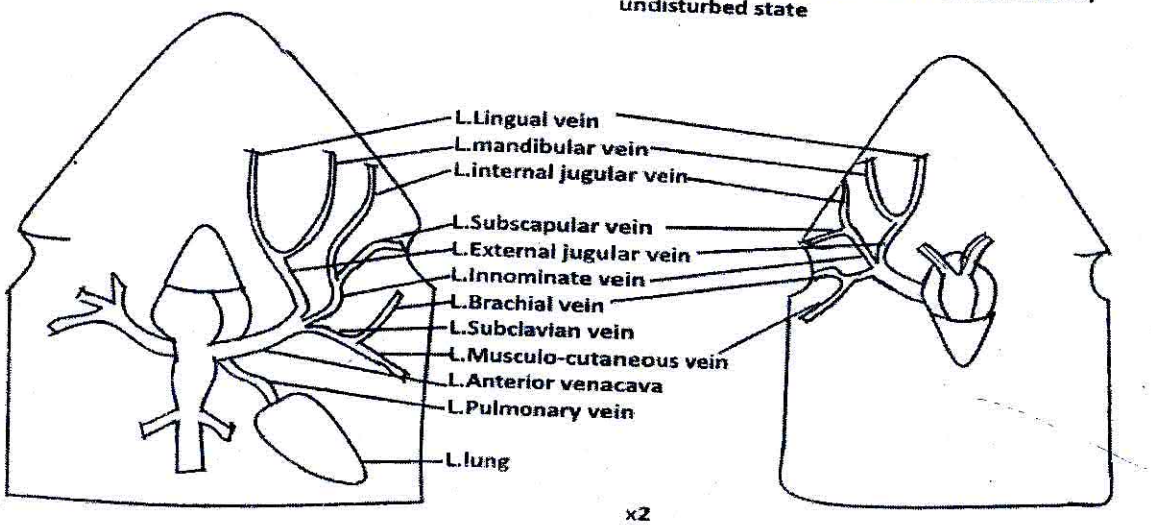
The vessels draining the head region are

Sinus venosus, anterior venacava, **innominate vein**, internal jugular vein draining the brain, eye and dorsal side of the head.

External jugular vein receives from lingual vein draining the tongue & hyoid and mandibular vein draining the lower jaw.

Blood vessels draining left side of the skin, head and chest region wth the heart displaced anteriorly

Blood vessels draining the right side of skin, head and chest region with the heart in situ/ undisturbed state



x2

THE VESSELS THAT DRAIN THE THORACIC REGION ARE;

Pulmonary vein draining the lungs, sinus venosus supplying the heart, anterior venacava **Innominate vein**, subscapular vein draining the dorsal surface of the shoulders, **Subclavian vein**, brachial vein draining the fore arm and **musculo-cutaneous vein** draining the skin and muscles of the body wall.

THE VESSELS SUPPLYING THE HEAD REGION ARE;

Truncus arteriosus, carotid arch, lingual artery/external carotid artery, the ***carotid labyrinth***, and internal carotid artery

The **lingual artery/external carotid artery:** supplies blood to the tongue and the lower jaw and hyoid.

The **internal carotid artery** :supplies the upper floor of the mouth and brain

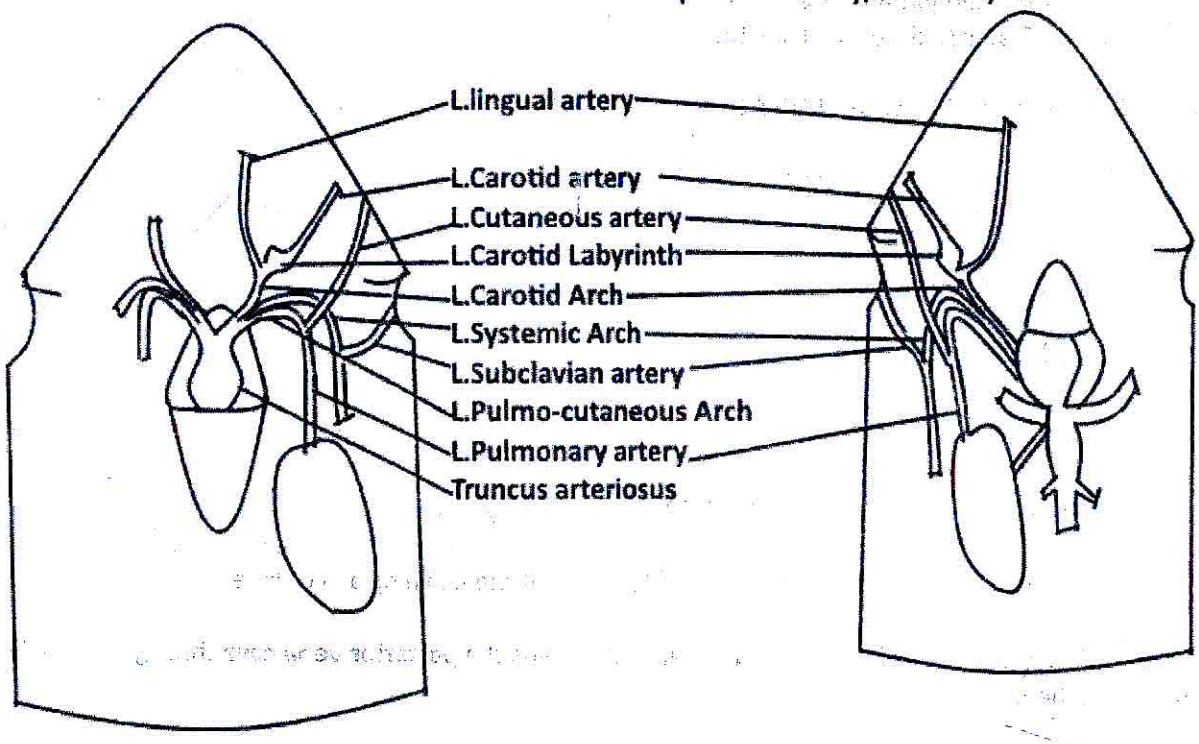
NOTE: The carotid labyrinth where the internal carotid artery joins the lingual artery

The vessels supplying the thoracic region are;

Truncus arteriosus ,pulmo-cutaneous arch, pulmonary artery supplying the lungs ,cutaneous artery supplying the skin, systemic arch, and subclavian artery supplying the fore arm.

Blood vessels supplying the left side of skin ,head and chest region with the heart in undisturbed state.

Blood vessels supplying the right side of skin,head and chest region with the heart placed dorsally/anteriorly



THE THORACIC REGION

it mainly contains the heart and the lungs and the vessels found with the region. The vessels with in thoracic region are both veins that drain the region and the arteries that supply the region. The thoracic region lacks a diaphragm and rib cage that would separate it from the abdominal and the head regions. Thus the lungs which are found in thoracic region overlaps with the liver lobes which are found in abdomen

THE ABDOMINAL REGION

The gullet, stomach and the duodenum are found on the left side of the animals (toad) while the ileum and the colon belong to no particular side. The rectum is the middle way.
The associated organs of the alimentary canal on the left side are the pancreas, and the left ovary, oviduct, ovisac and left liver lobe.

Other organs that are found on the left side of thoracic and abdominal region which are not part of the digestive system are the spleen, left kidneys, testis, urethra, vesicular seminalis, ovary, oviduct, ovisac and left lung.

Stretch the stomach and pin it to the left of the animal without tearing the pancreas and mesentery of the duodenum. Loosen the ileum and rectum by cutting their mesentery.

Stretch the ileum and pin it to the left of the animal .open pelvis girdle, clear off unnecessary materials to expose the features, draw and label the dissection.

VESSELS DRAINING THE ALIMENTARY CANAL AND ASSOCIATED ORGANS

Alimentary canal is drained by **hepatic portal vein** which branches into

- **Gastro-duodenal vein** which further divide into
- **Gastric vein** draining the stomach, and
- **Duodenal vein** draining duodenum. Hepatic portal vein further gives another branch of mesenteric which divides to form
- **Intestinal veins** draining the ileum.
- **splenic vein** draining the spleen, and
- **Rectal vein** draining the rectum.

Note: spleen *is not an associated organ with the alimentary canal*

The hepatic portal vein divides into two branches, each of them joining a liver lobe.

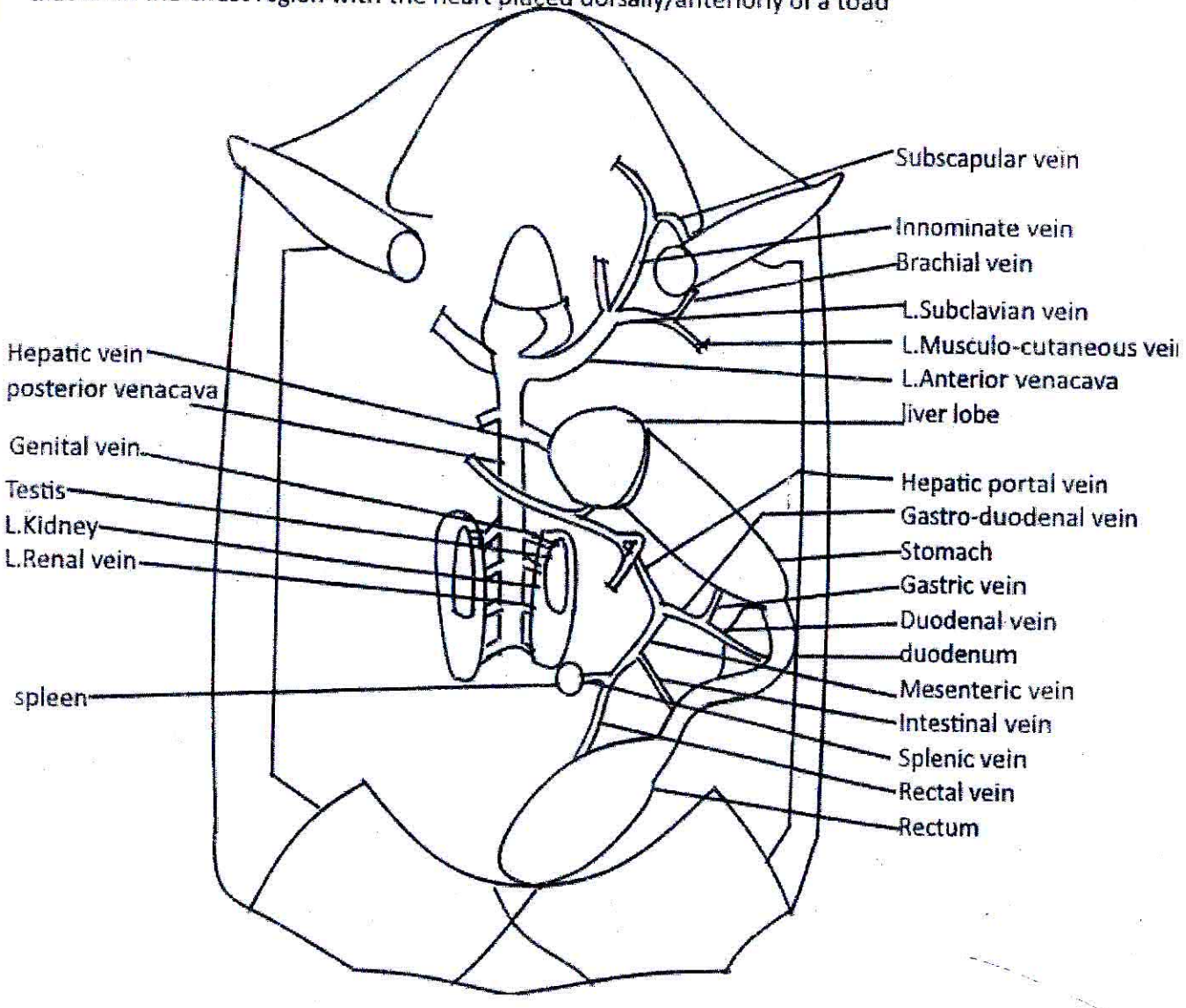
The liver lobes are drained by the **hepatic vein** which joins the **posterior vena cava** through which blood enters the heart.

ABDOMINAL REGION

It stretches from the liver down to the bladder. The liver and bladder and any other many organs between them are found in the abdominal region and hence are called abdominal features.

NB: The hepatic portal vein has other branches which do not drain the digestive system, the splenic vein draining the spleen and anterior abdominal vein which drains the thighs intestinal vein of hepatic portal vein divided into numerous small capillaries which are spread along the long ileum to increase surface area for absorption of digested food.

Drawing of blood vessels draining digestive system, visible organs in the visceral region and those that drain the chest region with the heart placed dorsally/anteriorly of a toad

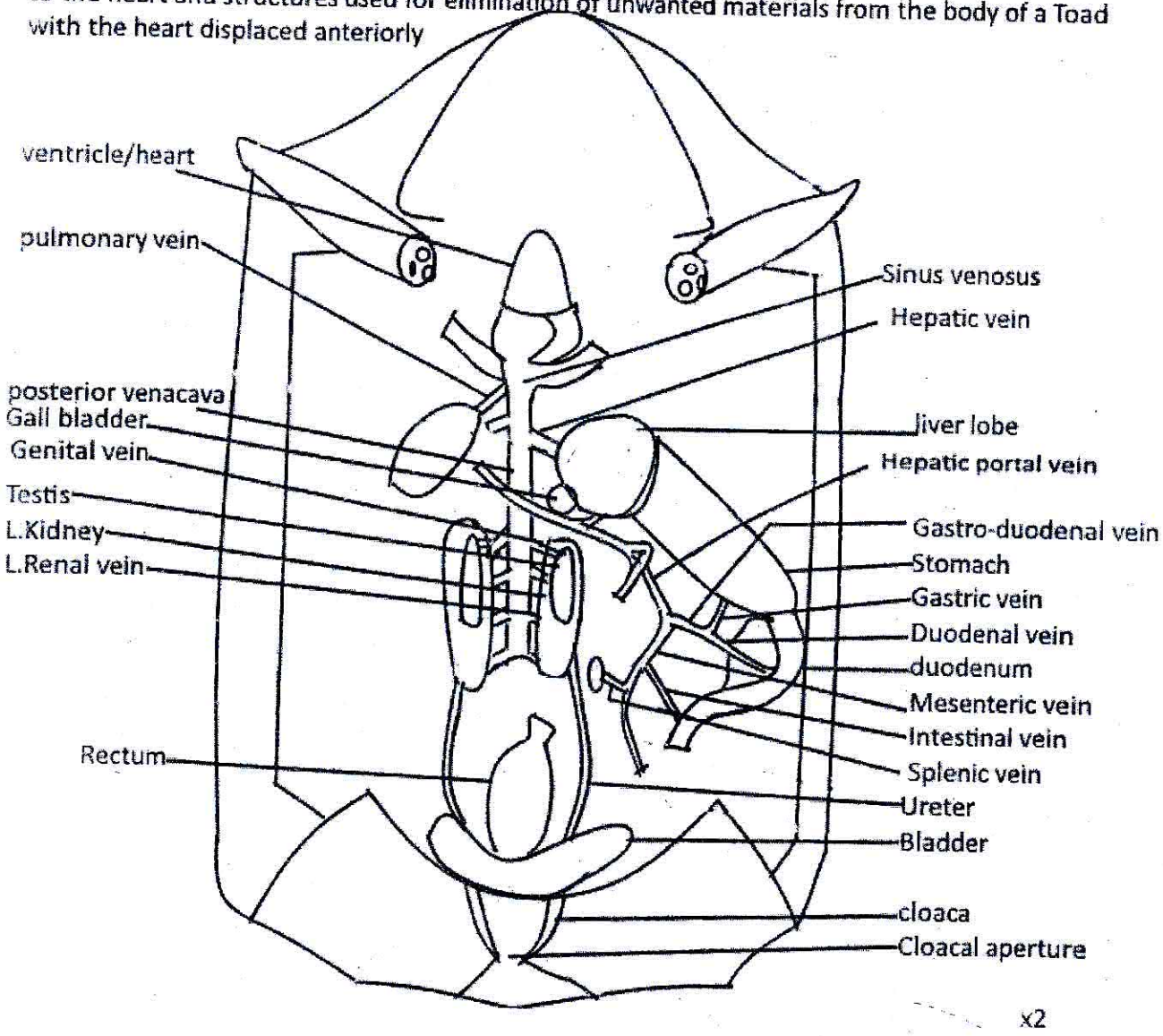


EXCRETORY SYSTEM

This is the system of organs that moves metabolic waste materials from the body. it consists of the following organs or features .the kidney, lungs, ureter (wolffian duct), bladder and **cloaca** which is exposed when the pelvic girdle is bisected.

The enlarged and elongated kidney filters the wastes from the **blood** to form urine. Urine flows through the long, tubular and thin **ureter** then into the bladder .The **bladder** which is membranous, broad and bilobed allows temporary storage of urine before it passes into the **cloaca** .Then eliminated from the body through the **cloaca opening/aperture** which is moist, narrow and constricted.

Drawing of blood vessels carryng blood fromorgans located on the left half of the abdominal cavity back to the heart and structures used for elimination of unwanted materials from the body of a Toad with the heart displaced anteriorly



x2

VESSELS SUPPLYING ALIMENTARY CANAL AND ASSOCIATED ORGANS

The main artery supplying the alimentary canal is the **systemic artery** which branches into

- **Coeliaco-mesenteric artery** which future divides into **coeliac and mesenteric arteries.**

The <u>coeliac artery</u> divides into

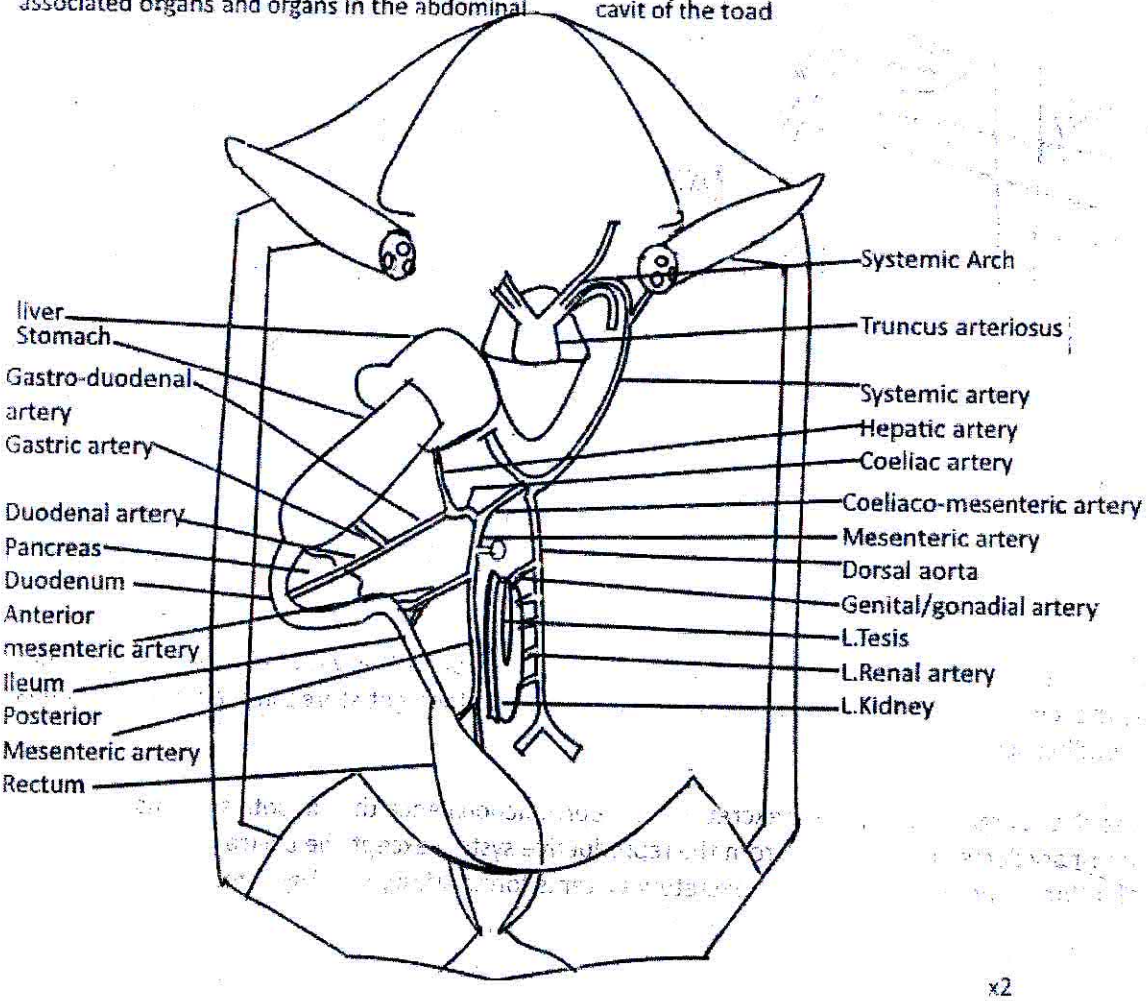
- **Hepatic artery** supplying the liver lobe, **gastro-duodenal artery** that further divides into the
- **Gastric artery** supplying the stomach, and
- **Duodenal artery** supplying duodenum.

<u>Mesenteric artery</u> divides into

- **splenic artery** supplying the spleen,
- **anterior mesenteric artery** supplying to most of the intestines and
- **Posterior mesenteric arteries** serving the lower intestine and the rectum.

NB. The splenic artery supplies the spleen which has no digestive function .thus should not be included in the drawing.

Drawing showing blood vessels supplying the alimentary canal which is displaced to its right with its associated organs and organs in the abdominal cavit of the toad



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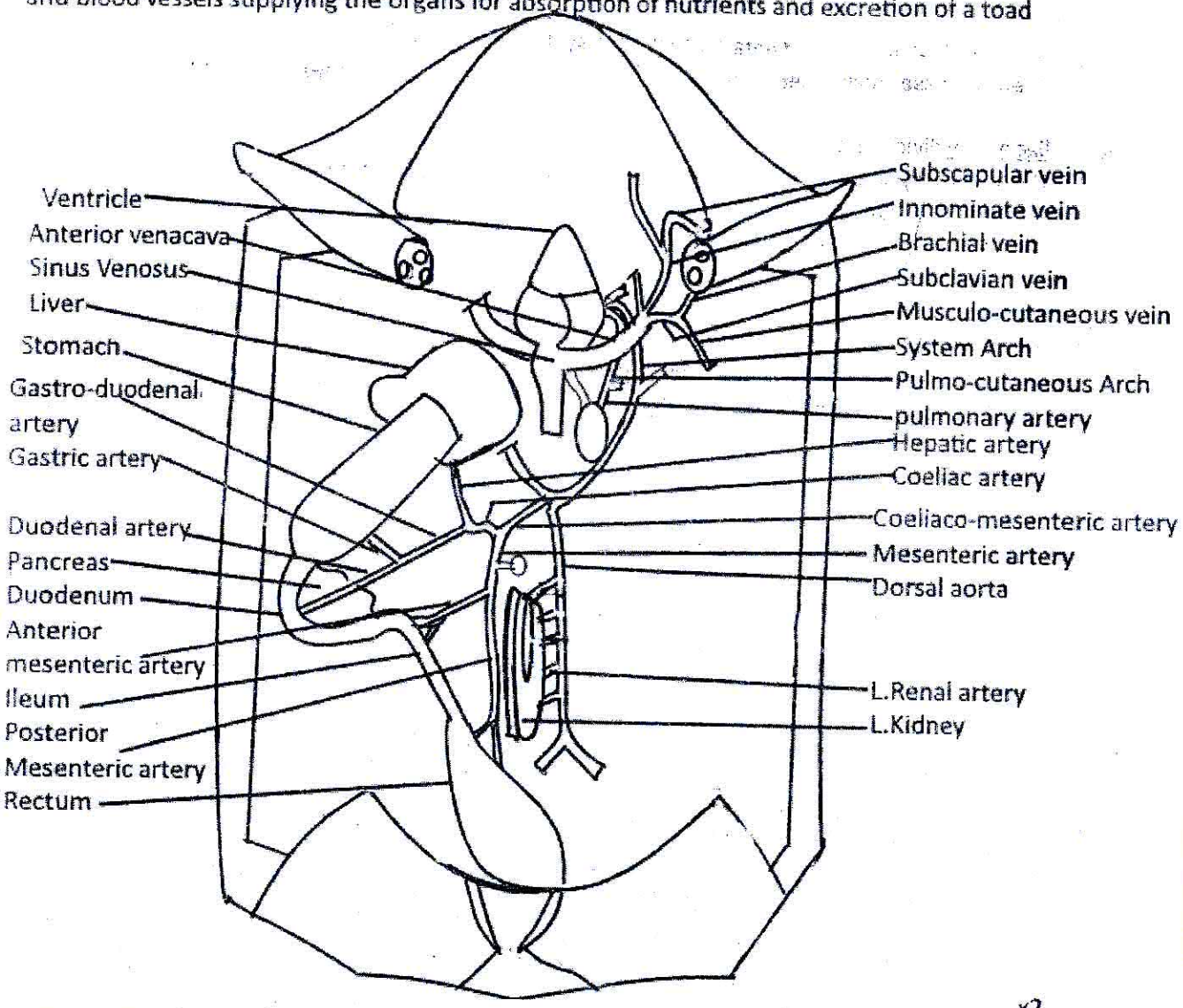
Drawing showing the main blood vessels returning blood from the trunk region to the heart turned over and blood vessels supplying the organs for absorption of nutrients and excretion of a toad



x2

REPRODUCTIVE SYSTEM

This is the organ used for sexual reproduction.The male reproductive system involves the testes, vasa efferentia, kidney, ureter, vesicula seminalis and cloaca.

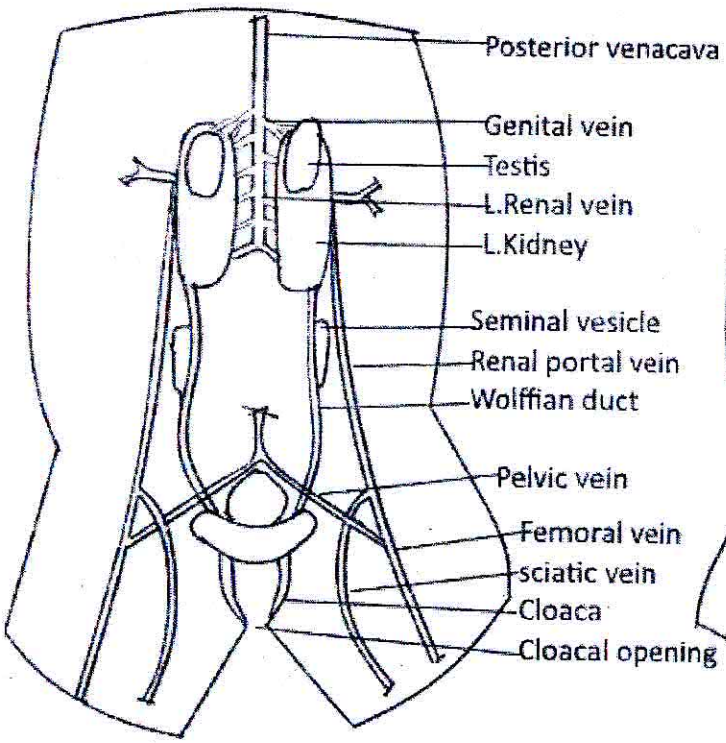
The ovoid, cream testes produce the gametes which pass through the vasa efferentia to the kidney tubules, the kidney tubules empty the gametes into the ureter then get stored in the vesicula seminalis until breeding occurs.

NB: Some of the organs are used for excretion and reproduction hence they in both systems.
NB: The urinary ducts are separated from the reproductive system except **the cloaca.**
A combination of the reproductive and excretory systems forms **urinogenital system.**

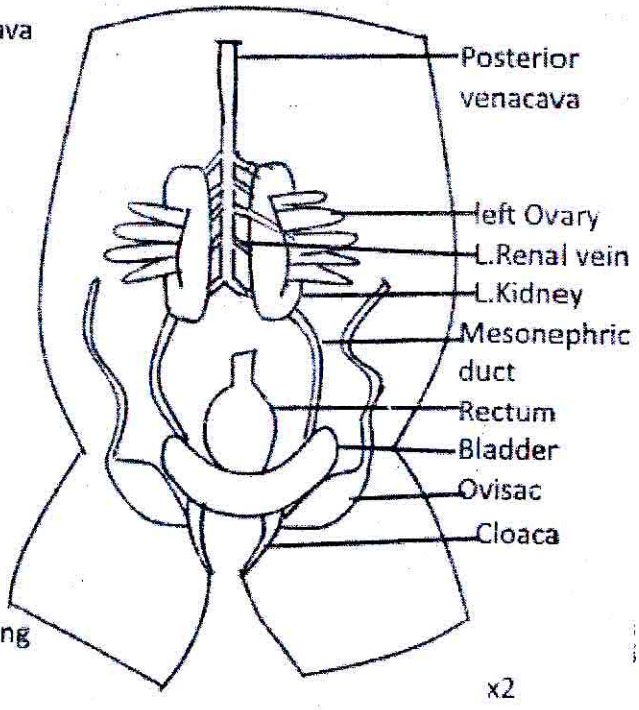
The female reproductive system is made up of the ovaries, oviducts/fallopian tube (mullerian ducts) **ovisac** and cloaca. **Ovisacs** are swellings at the posterior end of the oviducts

The membranous numerous flattened and irregularly lobed ovaries produce the ova .**Thin long and coiled oviducts for passage for the ova to exterior.**

Drawing showing male urinogenital system of a toad and blood vessels draining hind limbs and pelvic region



Drawing showing female urinogenital system



THE CLOACA

It has narrow lumen, muscular elastic wall, smooth inner lining, moist and constricted cloaca opening /aperture.

Cloaca opening is dorsal laterally located at the posterior end of the middle line of the body trunk.

Adaptations of the cloacal opening to its function

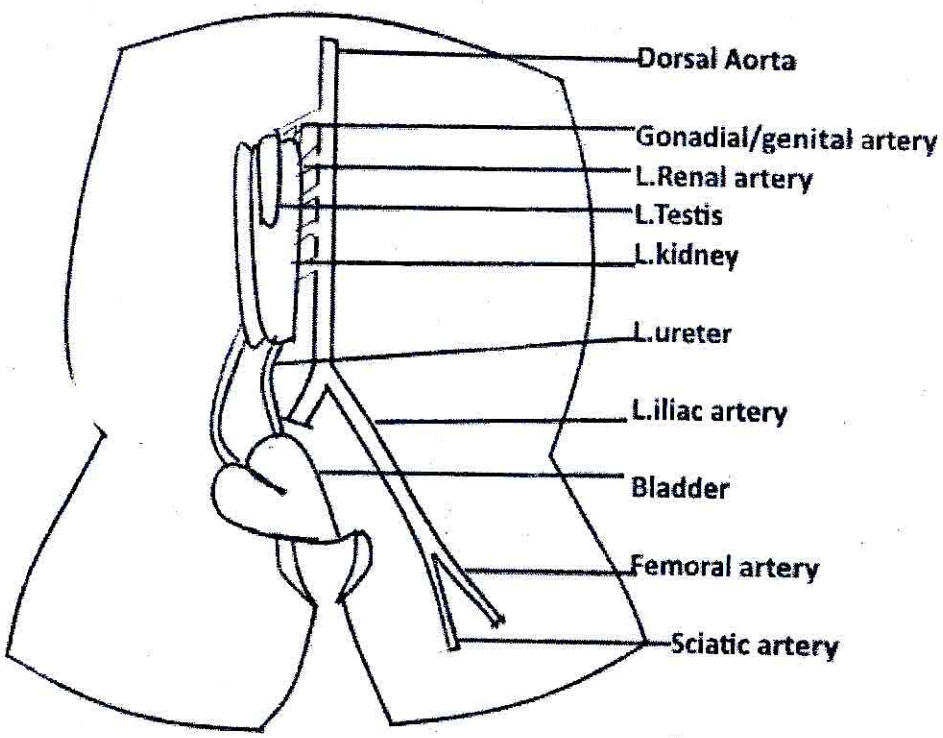
- It has elastic muscular wall to allow passage of large materials.
- It has smooth inner lining for easy passage of materials.
- It is tubular to allow passage materials.
- Its open is narrow to regulate egestion.
- Its opening is constricted /folded to allow egestion of a large size.
- Its opening is moist for easy egestion

BLOOD SUPPLY TO THE KIDNEY GENITALS AND HIND LIMBS

From the dorsal aorta, small branches, the renal arteries pass to the kidney, **paired** genital arteries/**gonadial arteries** pass to the reproductive organs from the dorsal aorta or the most anterior pair of renal artery.

Hind limbs are supplied by the **iliac arteries,which** are branches of dorsal aorta which eventually pass into the hind limbs where they divide into the **femoral and the sciatic arteries**

Drawing showing blood vessels that supply Urinogenital system and the hind limbs of a toad



x1

THE BODY CAVITIES

The body cavities of the toad are not distinctively separated .this leads to extending of some organs from one cavity to another. The toad is divided into four body regions the ***head, thoracic, abdominal and pelvic region.***

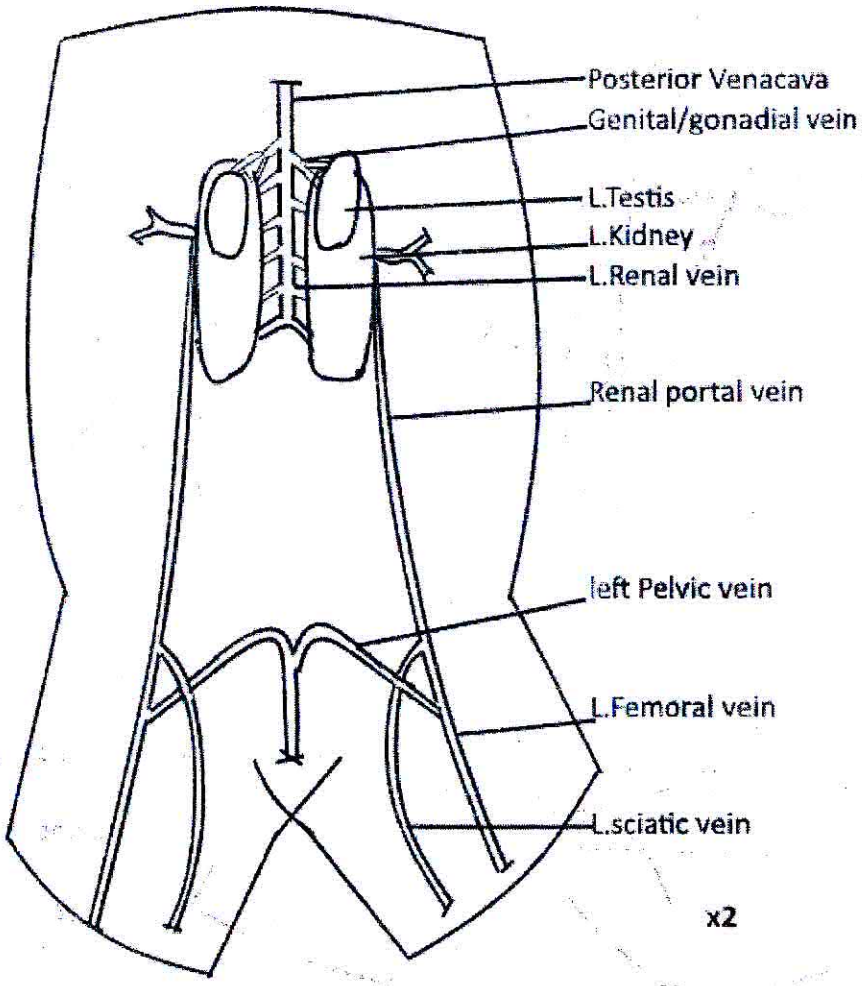
The pelvic region: This region mainly contains the pelvic activity containing the cloaca.
The region also contains vessels like the **pelvic veins** which fuse to form the **anterior abdominal vein** which pours blood from the thighs into the **hepatic portal vein.** it is not a so clear a region.

THE HIND LIMBS /THIGHS

The left and right hind limbs have the same vessels or blood circulation. They are drained by the outer **femoral** and inner **sciatic veins** which are cross connected by sciatic loop.
The femoral and sciatic veins join just inside the abdominal cavity to form **renal portal vein** which joins the kidney.

Another alternative route is a branch of the **femoral veins,** the pelvic veins, which join to form anterior abdominal vein. This passes forward in the mid line of the body just beneath the skin to join the hepatic portal vein immediately before its entry to the liver.

Drawing showing blood vessels draining Hind limbs and the Urinogenital system of a male toad

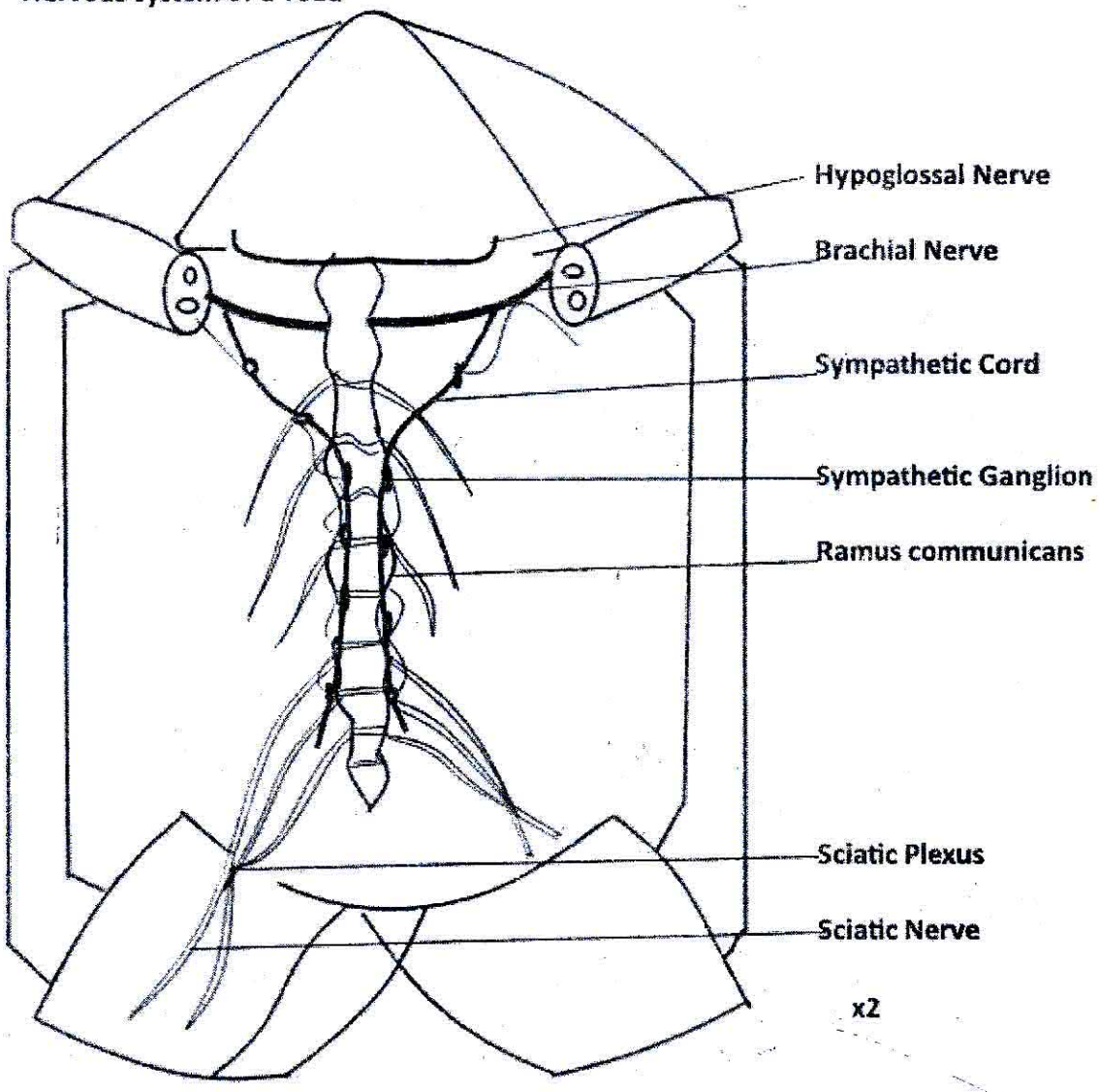


THE VENTRAL BRANCHES OF THE SPINAL NERVES AND SYMPATHETIC NERVOUS SYSTEM

It consists of the main spinal cord with 10 nerve fibres projecting from either of it. the first nerve fiber, **hypoglossal nerve,** is connected to the head .the next two nerves are found in thoracic region (thoracic nerves).the next three are found in the abdominal region (abdominal nerves).the last four nerves connect to the hind limbs.

They join in the thigh to form **sciatic plexus** from which emerge the outer main **sciatic nerve** and inner small **cuccygeal nerve** .all the spinal nerves are connected to the sympathetic cord from the brains at the sympathetic ganglia by the loop called **Ramus communicans**

Drawing showing the ventral braches of the spinal nerves and the sympathetic Nervous system of a Toad



- Possesses external ear lobes /pinnae
- Body /skin is covered with hairs /fur
- Possesses external genitalia, like vaginal opening (vulva), clitoris and scrotal sac and prepuce opening for males.
- Possession of nipples /teats which bear outlets of mammary glands.

Internal mammalian features

- Possession of heterodont teeth which is a set of different type of teeth.
- Possession of the diaphragm which is an internal structure
- Possession of a diaphragm separating the body cavity into two i.e. thoracic cavity carrying the heart and lungs and abdominal cavity containing the intestines, and other organs.
- Dental formula **($I^{1}/_{1}$, $C^{0}/_{0}$, $Pm^{0}/_{0}$, $M^{3}/_{3}$)**

Adaptations of the rat to survive in its habitat

- *Its external ears are funnel shaped which eases trapping of sound waves for easy hearing and to increase its sensitivity to sound.*
- *Eyes are dorsal-laterally located midway on the head for wide vision/to increase the field of view.*
- *Narrow opening for easy smelling and breathing thus are sensitive smell.*
- *Whiskers/vibrissae/ long hairs brittle in nature makes it easy to detect the diameter of the burrow.*
- *Mouth ventrally located for easy ingestion of food materials.*
- *Tail is long and tapers anteriorly, solid /hard, long and flexible for defense by whipping /lashing the enemy.*
- *Fur to reduce water loss/conserve heat.*
- *Pointed claws for firm grip/support/easy holding of food/digging tunnels/burrows/escape predation*
- *The protruding incisors which are sharp top/ chisel shaped, long hard and curved in wards for easy cutting of food and for defense by biting the enemy.*

THE HEAD

It is tapering anteriorly with a cone shape .it is loosely attached to the body trunk by a neck.
The tapering head provides a streamlined shape for easy entrance into the burrows or to reduce air resistance for easy locomotion .it has little fur to reduce insulation of the sensory organs in the animal's head.

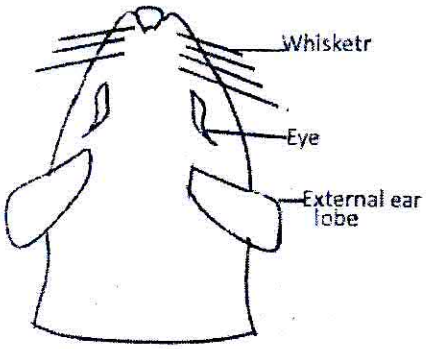
Structures on the head
The head has various features which include the Pinnae (external ears), eyes, external Nares (nostrils), mouth, and vibrissae (whiskers.)

THE PINNAE

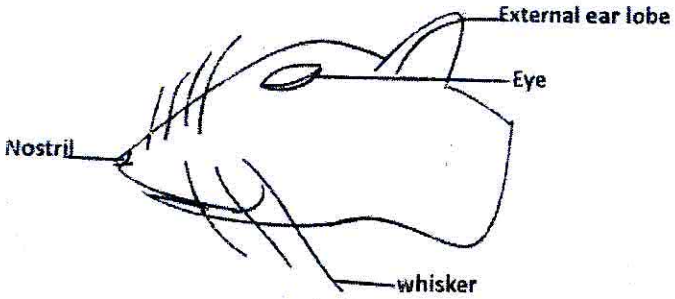
- It is dorsal –laterally locate at the posterior end of the head and posterior to the eye flexibly attached to the end and expanded out ward(funnel shaped).its funnel shape eases trapping of sound waves for easy hearing and to increase its sensitivity to sound .
- It has little fur to encourage heat loss
- They are one pair.

- Its many blood capillaries are close to inner surface to encourage heat loss

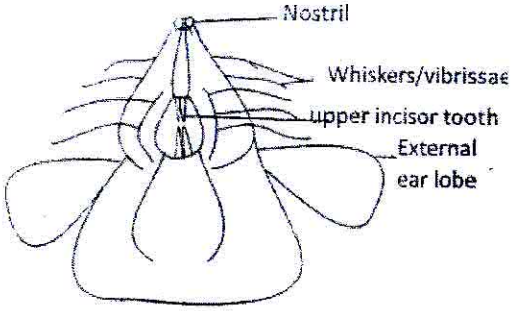
Drawing of the dorsal view of the head region



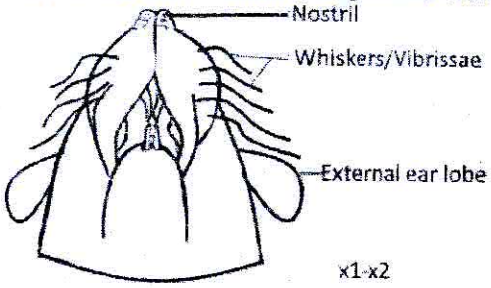
Drawing showing the side veiw of head region of a rat



Drawing of the ventral view of the head of a rat



Drawing of ventral view of the head showing structures for sensitivity



THE EYES

- They are dorsal-laterally located midway on the head for wide vision/to increase the field of view
- They are one pair and are sensitive to light.
- They are small and bead–shaped with hairy eyelids and nictitating membrane which is transparent located in the interior corner of the eye.
- It is anterior to the external ears.

THE EXTERNAL NARES /NOSTRILS

They are narrow opening, one pair, comma shaped, surrounded by smooth skin and anteriorly located on the head. Its location is for easy smelling and breathing thus are sensitive smell.

THE MOUTH/BUCCAL CAVITY

The **tongue**, which

- Broad /flat to increase the surface area for tasting and rolling food.
- Long to roll food easily for swallowing
- Flappy (flat) and flexible for easy rolling of the food.
- It has a large base to increase surface area for firm attachment.

MOUTH

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MOUTH

- It is ventrally located on anterior end of the head below the nostrils for easy ingestion of food materials.
- It is cone shaped with the sides of upper lips folded inside into diastema for easy nibbling.The upper lip also has a cleft to expose the incisors for easy nibbling/gnawing.
- The rugae (folds /ridges) of hard plate, for gripping food during grinding.
- Soft plate, which is smooth for easy swallowing

ARRANGEMENT OF TEETH AND ADAPTATIONS

- A pair of incisors at front of both upper and lower jaws while three pairs of molars at the back of the upper and lower jaw. **Molars** ,hard, broad top surface, rough top surface big sized:
- The protruding **incisors** which are sharp top/ chisel shaped, long hard and curved in wards for easy cutting of food and for defense by biting the enemy.
- Incisors are found at the anterior end of the jaws to ease cutting/ nibbling of food. Molars at back to exert maximum force for chewing food.
- Broad top of molars provide a large surface area for chewing food /Flat topped molars, with cusps and ridge to increase the surface area for grinding food.
- Hard to cut food/chew food

THE VIBRISSAE/WHISKERS

These are many bristle/stiff, long hairs arranged in rows along the sides of the anterior end of the head. The length and brittle nature of whiskers makes it easy to detect the diameter of the burrow. Thus they make the animal sensitive to the slightest touch.

THE TRUNK

The short neck attaches the head to the trunk. Structures found on the trunk, include the limbs, tail and external sex features /genital.

THE LIMBS

The rat has two pairs of limbs, a pair of fore limbs and a pair of hind limbs.

THE FORE LIMBS HAVE THE FOLLOWING CHARACTERISTICS

- They are short and stout to absorb shock on landing
- They are less muscular
- They have four well developed digits with the fifth greatly reduce to a small stub.
- They have hairless sole with many pads (digital and foot pads) to reduce noise making when moving for easy escape.
- They have curved, hard, elongated and pointed claws for defense by scratching the enemy and digging burrows for protection or breeding. Claws are also used for firm gripping on the rough surface during locomotion.

THE HIND LIMBS HAVE THE FOLLOWING CHARACTERISTICS

- They are long muscular for fast and sudden movement to escape enemies.
- They have curved, hard, elongated and pointed claws for defense, digging burrows and for firm gripping on the rough surface.
- They have hairless sole with many pads (digital and foot pads)

The fore and hind limbs share many features in common .they both have claws, smooth, sole, digits/toes, sole and digital pads and jointed.

CHARACTERISTICS OF THE TOES/digits

- They are jointed for flexibility during movement.
- They have soft pad to reduce the noise when moving for easy escape.
- The claws are curved and pointed for easy holding of food or digging burrows.
- They are well spread out for support.

Differences between fore and hind limbs

Fore limb	Hind limb
It is shorter	It is longer
It has four well developed digits	It has five well developed digits
The first digit is reduced with a small nail	The first digit is fully developed
Less muscular	More muscular/much thicker

The use of joints in the limbs is to increase their flexibility

The length of the hind limb doubles that of the fore limb **i.e.** The ratio of the fore to hind limb is **1:2** to generate propulsion force during locomotion for fast movement.

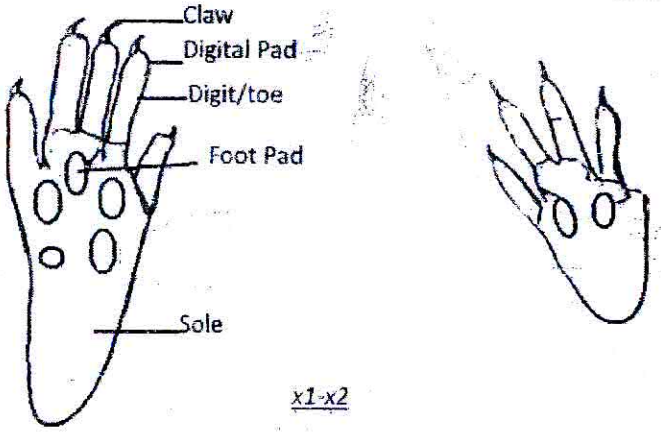
This great length together with its muscular nature gives a rat a greater forward force during darting-hopping movement.

The fore and hind feet have many structures in common. Both feet have digits, sole and digital pads, hairless sole and claws.

However the hind foot has five digits while the fore one has four well developed digits.

The hind foot also has longer sole than the fore foot.

Drawing of the ventral surface of the left hind foot and fore foot



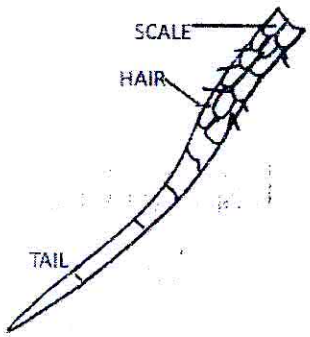
x1-x2

THE TAIL:

It is attached to the posterior end of the body trunk. The tail tapers posteriorly to make it flexible so as to drive away parasites like fleas.

It is characterized by;

- Having rows of scales around, which are closely packed for protection against physical injuries and for reducing water loss/prevent desiccation?
- The tail is long, about the same length as the body trunk to balance the body.



- It length equals to the rest of the body for support /balance /maintain raised when moving .or for defense y whipping the enemy at the distance.
- It tapers anteriorly, solid /hard, long and flexible for defense by whipping /lashing the enemy.
- It has short, stiff/bristle hair emerging from between the scale for increase sensitivity to touch.
- Many scales which are anteriorly attached and overlaps posterior to allow heat loss.

NB: Tail being half the length of the whole body helps to give support/balance/maintain raised head/drive away other organisms/predators/defence

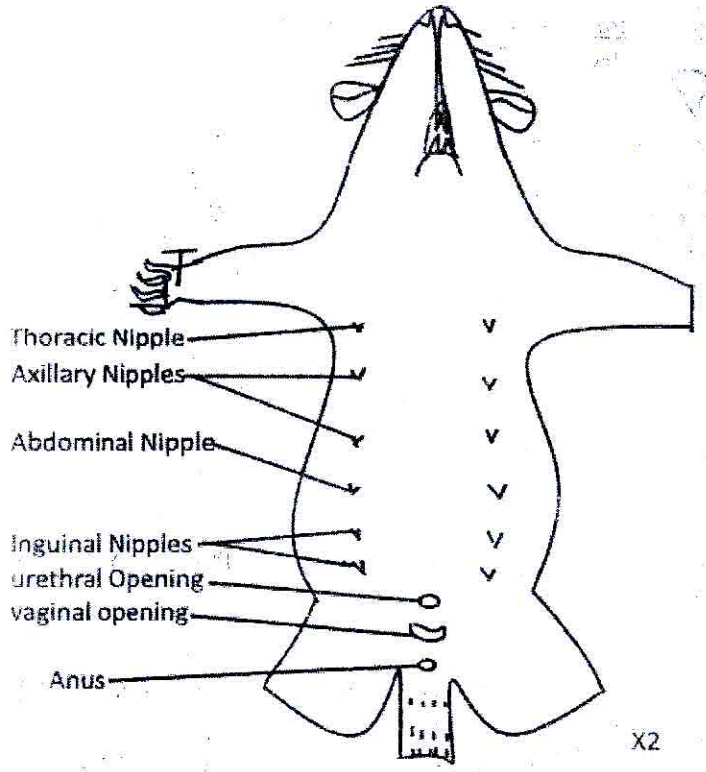
Qn. Describe the attachment and pattern of arrangement of the scales

The scales: anterior *end attached, posterior end free; arranged close to each other, anterior scales overlaps posterior scales in rows and scales next row lie in between those in previous row.*

Adaptation

- Overlap allows for heat escape
- Close to each other for protection
- Close to each other to conserve water

Drawing showing visible structures on the vebntral surface of a RAT



SEX IDENTIFICATION

CHARACTERISTIC OF FEMALES;

- Have vulva/genital aperture on the ventral side.
- Have the small projection, the **clitoris** on the ventral side immediately above the vulva.
- Have two rows of teats /nipples on the ventral side of abdominal region, which bear outlets mammary glands.

THE VULVA in adult rats is open, smooth, oval/circular/round opening. It is found in the middle cross length between the hind limbs on the ventral side. It is moist and open for easy passage of materials. It is close and posterior the **clitoris** which is a small projection/protrusion***; solid; cylindrical; with a small opening at the tip and short scanty hair/fur.***

The clitoris is pointed and close and anterior to the vulva.

The nipples are in six pairs on ventral side of the thorax and abdomen. **Three pairs** are thoracic, **one** is abdominal and **two** inguinal (found in groin region).The teats are at the same distance from the longitudinal mid-line of the ventral side. Nipple; small projection; short; cylindrical; smooth; and solid

CHARACTERISTICS OF MALE

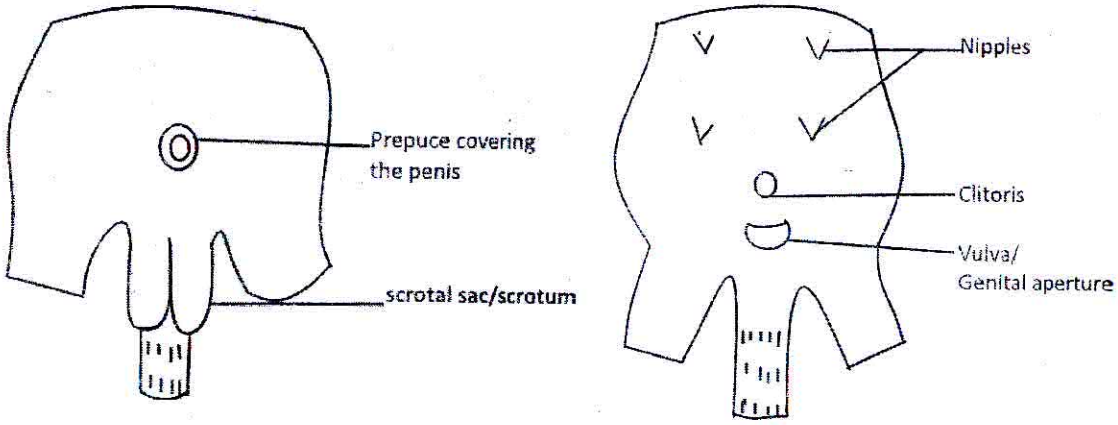
- Have a projection of prepuce covering the penis.
- Have the scrotal sacs protecting the testes.
- The dorso-posterior end is round to expanded testes on the ventral side.

PENIS is elongated/long, covered by a loose sheath/prepuce which is cylindrical, solid, with scanty hair, slit like aperture at the tip.

Scrotal sacs/scrotum, swollen, sac like, elongated, with short scanty hair and two swellings with a depression in the middle

The scrotal sacs are enlarged /dilated and elongated to accommodate large testes.

Drawing showing ventral view of Male and Female posterior region and abdominal surface



GENERAL ADAPTATIONS OF A RAT TO SURVIVE IN ITS ENVIRONMENT

- Has thick fur to reduce water loss /conserve heart /temperature regulation.
- Large expanded external ears for increased surface area for easy hearing /trapping sound waves.
- Has long, and bristle whiskers/vibrissae for increased sensitivity to stimuli of touch /detecting the size of burrow.
- Has elongated, pointed claws for firm gripping on the rough surface or for digging burrows /tunnels or for holding food of for defense.
- Has dorso–laterally located eyes for wide vision.
- Has long tail for balancing during movement or for defense at along distance.
- Has two pairs of muscular limbs foe support or for locomotion.
- Have narrow open nostrils for easy breathing or for easy smelling.
- Have many overlapping scales on the tail to reduce desiccation.
- Have sole pads to reduce noise making when moving for easy escape.
- Has streamlined and flexible body to easily enter the burrow.

BODY SYSTEMS

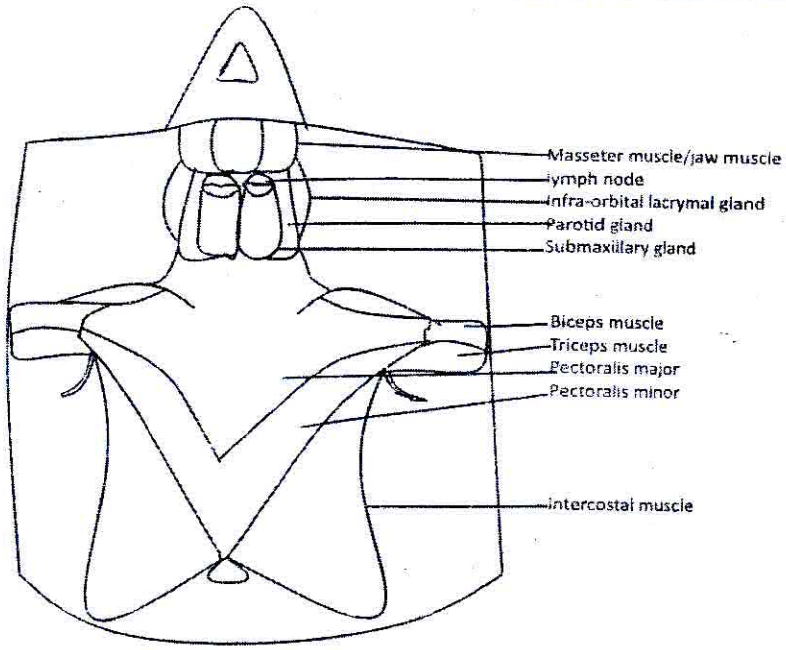
The body systems are exposed to study by opening internal cavities .before the internal cavities are opened, the skin has to be removed first by using a blank knife scissors.

The visible structures exposed on the body wall by removing the skin are called **superficial structures** like the **neck glands,** masseter (jaw) muscles, pectoral muscles, neck muscles, shoulder muscles, intercostal muscles, abdominal muscles and cutaneous nerves radiating from the arm pits ,lymph nodes in the arm pits, thigh muscles ,preputial glands ,femoral nerves ,and femoral vein.

If it is a female, thoracic abdominal and inguinal mammary glands are exposed .for the male the scrotal sacs are exposed.

NB: The incisor teeth and the tongue are not superficial because are not exposed by removing the skin but by the opened mouth.

A drawing showing the superficial structures of the neck, thoracic region and lower head region of the rat



THE NECK GLANDS

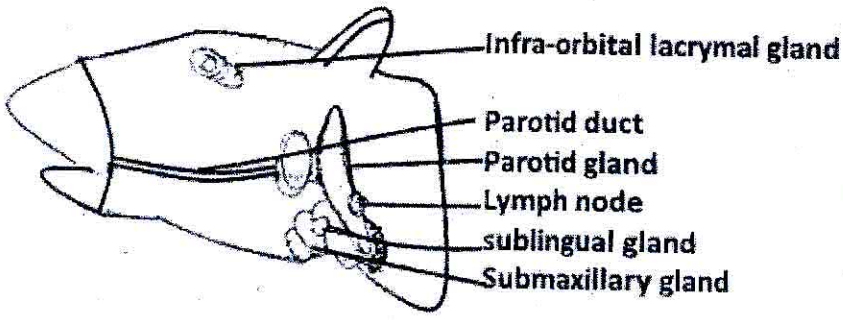
These include four types of glands which exist in pairs i.e. infra –orbital lachrymal gland, lymph nodes, parotid gland, and sub-maxillary gland; all are salivary glands except the lymph nodes.

Infra-orbital lachrymal glands which are for immunity and tear secretion respectively. Infra-orbital lachrymal and sub-maxillary are enlarged and muscular.

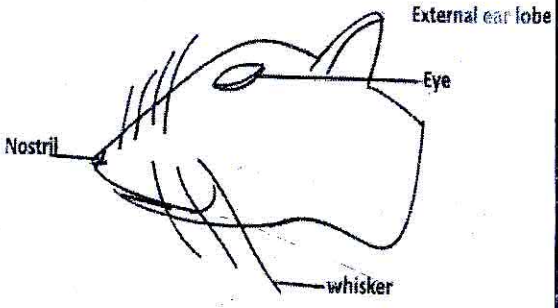
The **parotid gland** is spread and membranous and its secretion, the tears, is voided/empted into the mouth cavity through the duct seen on the body surface.

The **lymph nodes** are small bean shaped and exist in two pairs.

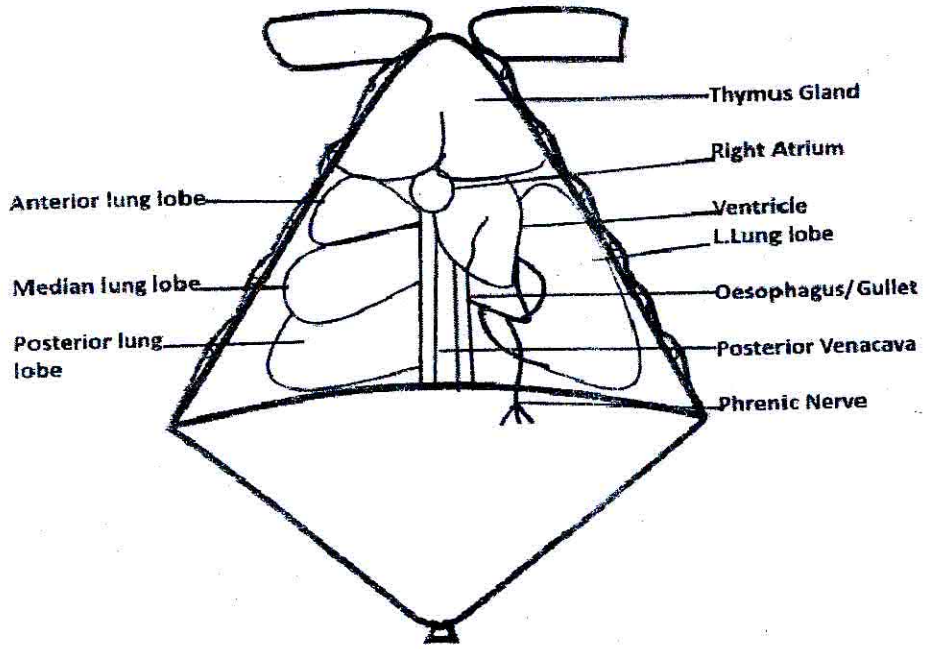
Drawing showing the features for secretion and passage of materials in the lateral neck and head regions of a rat



Drawing showing the side veiw of head region of a rat



Drawing of the structures in the thoracic region of a RAT in undisturbed state/situ



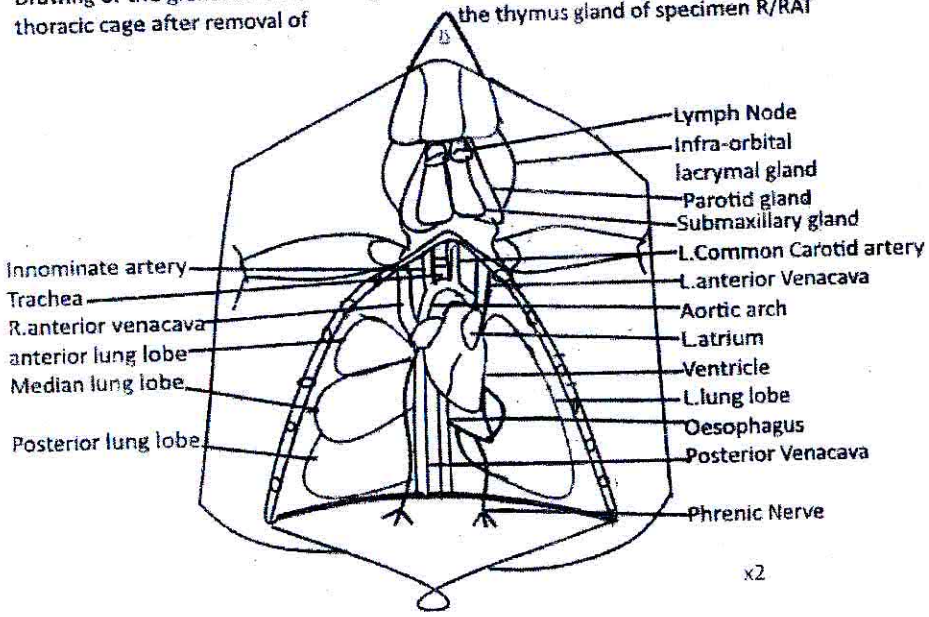
THE RESPIRATORY SYSTEM

TRACHEA:

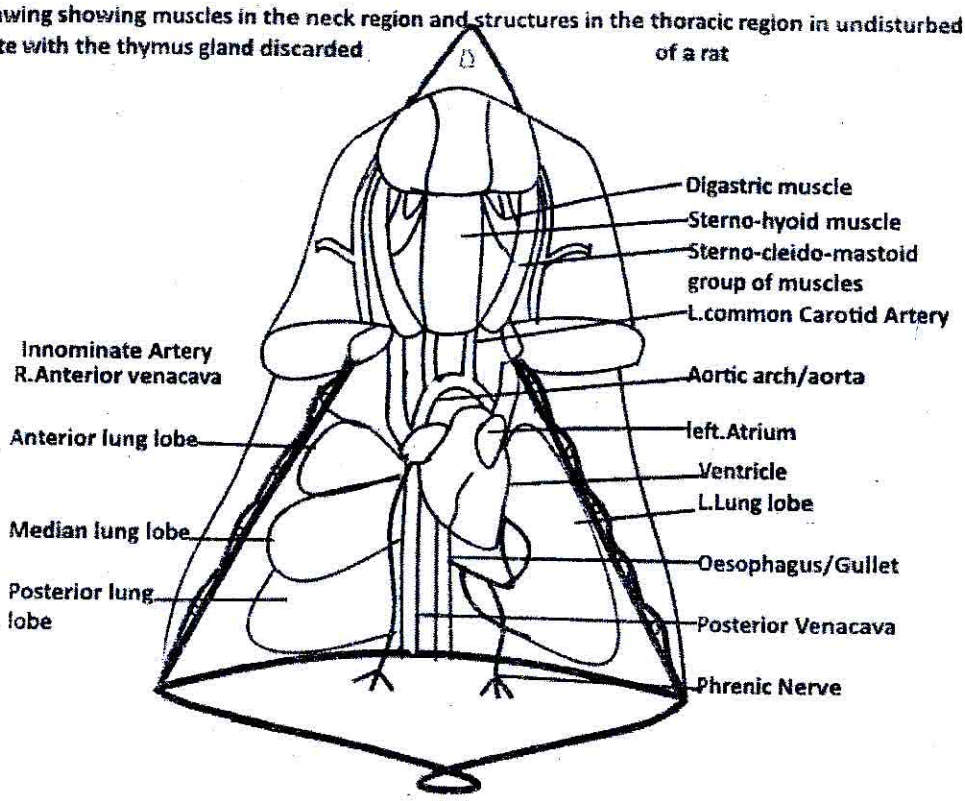
It is cartilaginous, rigid, ringed, hollow /open /tubular, and cylindrical. It is used as the passage for gases; it is adapted to its function by.

- Having rings for cartilage to keep it open for easy passage of gases.
- Being hollow to allow ventilation.
- Having muscle connection between the cartilage for flexibility.

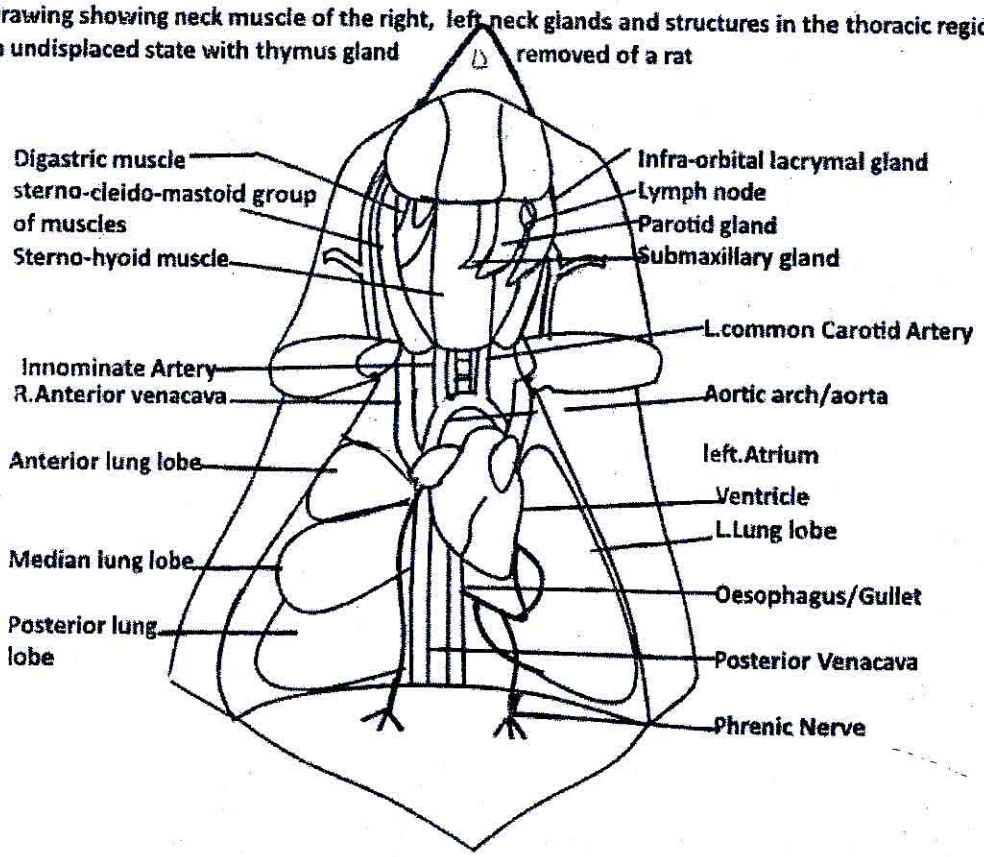
Drawing of the glands in the neck region/throat region and visible structures enclosed in the thoracic cage after removal of the thymus gland of specimen R/RAT



Drawing showing muscles in the neck region and structures in the thoracic region in undisturbed state with the thymus gland discarded of a rat



Drawing showing neck muscle of the right, left neck glands and structures in the thoracic region in undisplaced state with thymus gland removed of a rat



LUNGS

It is spongy, pink in colour and consists of numerous air sac.
it is adapted to its function by;

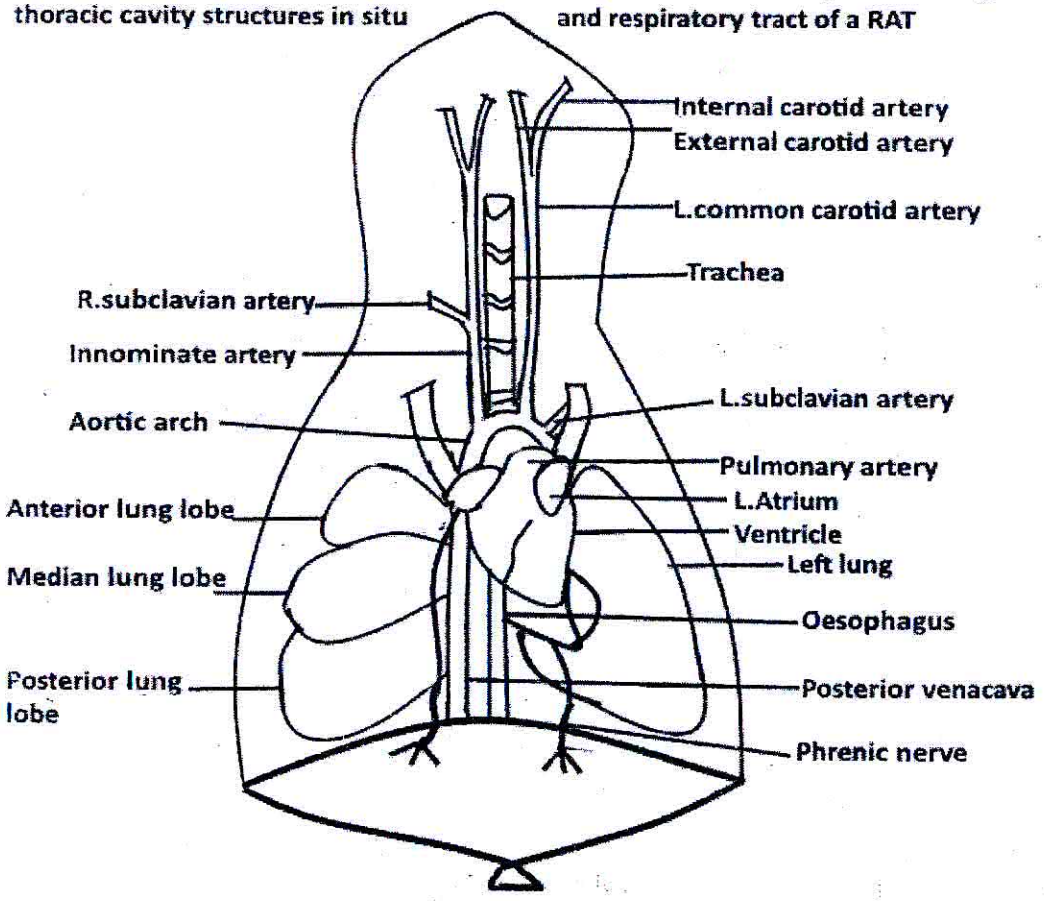
- Being spongy to allow easy distention with more air.
- Pink colour indicates a rich supply of capillaries that offer a large surface area for gaseous exchange.
- Numerous air sacs increase the surface area for gaseous exchange.

THE BLOOD VASCULAR SYSTEM

It contains of arterial and venous systems. Arterial system consists of vessels that supply the body tissues and are called **arteries.** Venous system consists of vessels draining the body tissues back to the heart.

VESSELS SUPPLYING THE THORACIC, NECK AND HEAD REGIONS

Drawing of blood vessels supplying the thoracic,neck and head region including thoracic cavity structures in situ and respiratory tract of a RAT



The **aorta/aortic arch** from ventricle of the, heart branches into three arteries, i.e. the **innominate** artery on the right, left **common carotid artery** and left **subclavian** artery.

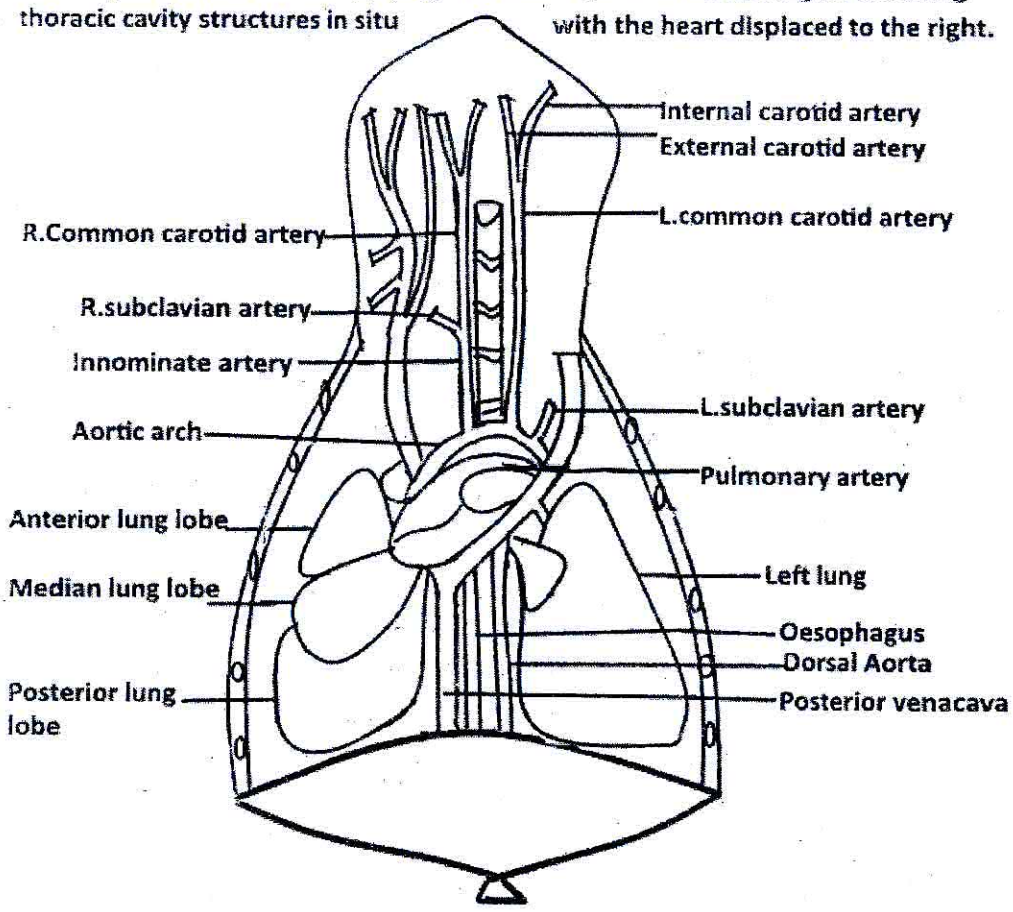
Innominate artery divides into the **right subclavian artery and right common carotid artery.**

The subclavian artery turns into the right axillary artery after giving off intercostal and vertebral artery. The **axillary artery** divides into brachial artery **supplying the arm** and cervical arteries supplying the neck muscles and the neck vertebrae.

The **right common carotid artery** divides into the **internal carotid** artery **and external carotid** artery. The internal carotid artery supplies *the brain and the deep region of the head* and external carotid artery *supplies the external parts of head.*

The **left common carotid artery** extends directly from the **aortic Arch** and then forks into internal carotid artery and external carotid artery.
The left **subclavian artery** divides like the right subclavian artery which serves the **fore arm** via the brachial and axillary artery.

Drawing of blood vessels supplying the thoracic,neck and head region including thoracic cavity structures in situ with the heart displaced to the right.



The aortic arch continues down beneath the left anterior vena cava to supply the organs posterior to the heart .it also gives off numerous **intercostal arteries** that supply the intercostals muscles.
From the right ventricle, arises **pulmonary artery** which supplies the lungs.
The vessels supplying the thoracic region are; aorta, **innominate** artery, subclavian arteries, vertebral arteries, and cervical arteries.
The right and left common carotid arteries divide into internal and external carotid arteries that supply the head

THE BLOOD VESSELS THAT DRAIN THE THORACIC, NECK REGIONS, AND HEAD REGION

The main large one vessel, the vena cava, draining into the right atrium, divided into three vessels.

- The posterior vena cava draining organs posterior to the heart.
- The right anterior vena cava draining the right side of the thoracic, neck and head regions.
- The left anterior vena draining the left thoracic, neck and head regions.

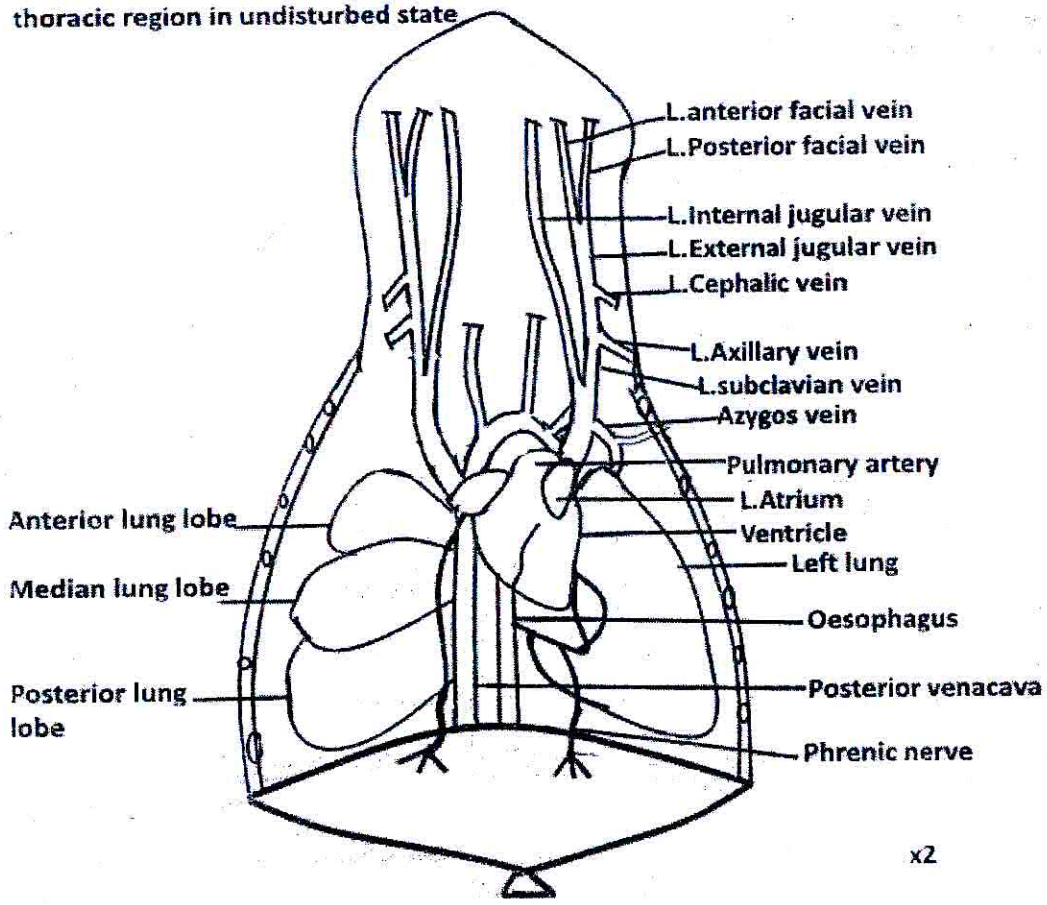
The vessels draining thoracic region are; posterior vena cava, pulmonary vein, left and right anterior vena cava, subclavian veins, axillary veins, and cephalic veins and Azygos vein.

The **cephalic** vein drains the arm and shoulder region;
The **axillary** vein drains the arm through brachial vein and the arm pit, and
The **Azygos** vein occurs on the left side of the thorax only and draws blood from both sides of thorax.

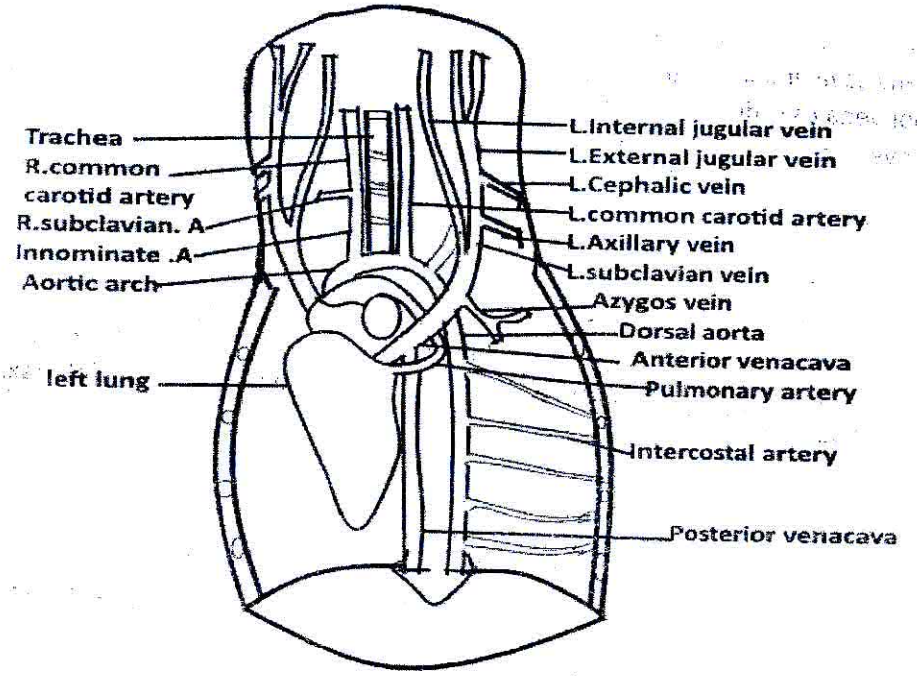
The **vessels draining the neck region** are; left and right anterior vena cava, subclavian veins external jugular veins, and internal jugular veins.

Posterior facial vein and **anterior** facial vein drain blood from the head, the **anterior facial veins** drains blood from the internal parts of head and **posterior facial vein** drains blood from the external parts of the head.

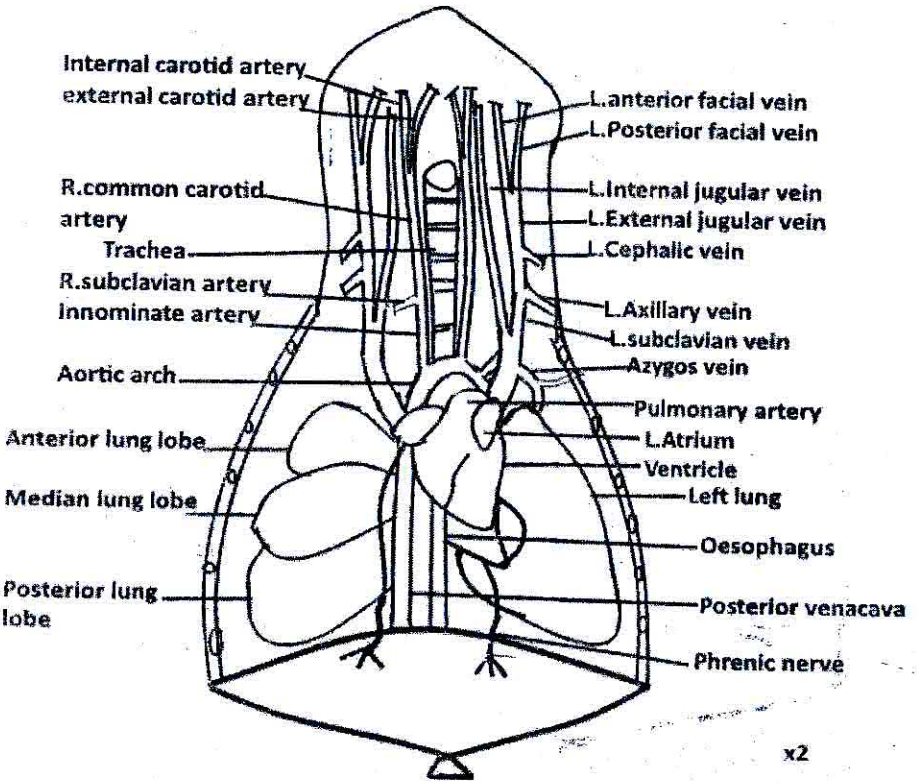
Drawing showing blood vessels draining head,thoracic region and structures in thoracic region in undisturbed state



Drawing showing structures for ventilation and blood circulation in the regions anterior to the diaphragm with the heart and left lung displaced to the right of the rat



Drawing showing the stuctures for blood circulation and ventilation in the regions anterior to the diaphragm without displacing the heart after removing the rib cage, shoulder and neck muscles of the RAT

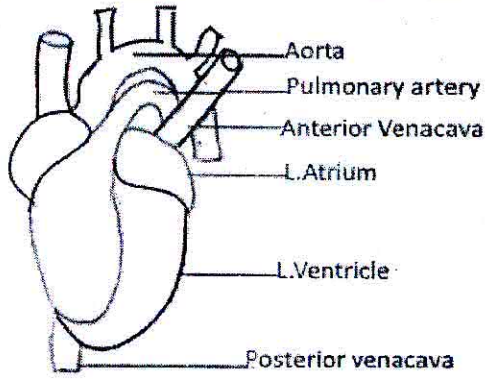


THE HEART AND its MAJOR BLOOD VESSELS

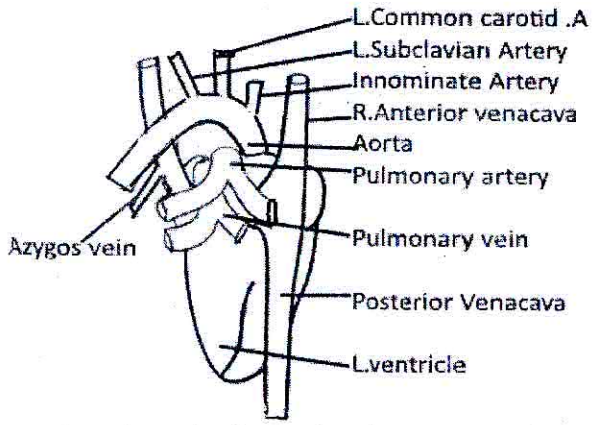
Position and shape:
The heart lies ventrally in the thorax; it is pear shaped, with the apex posterior and tilted to the left and the base, anterior giving way to the origin of the great vessels.

The heart is divided into four chambers with the ventricles appearing much larger than auricles because of their thick muscular walls that provide a strong force in pumping blood.

Dorsal view of the heart and associated blood vessels after thr lungs have been removed

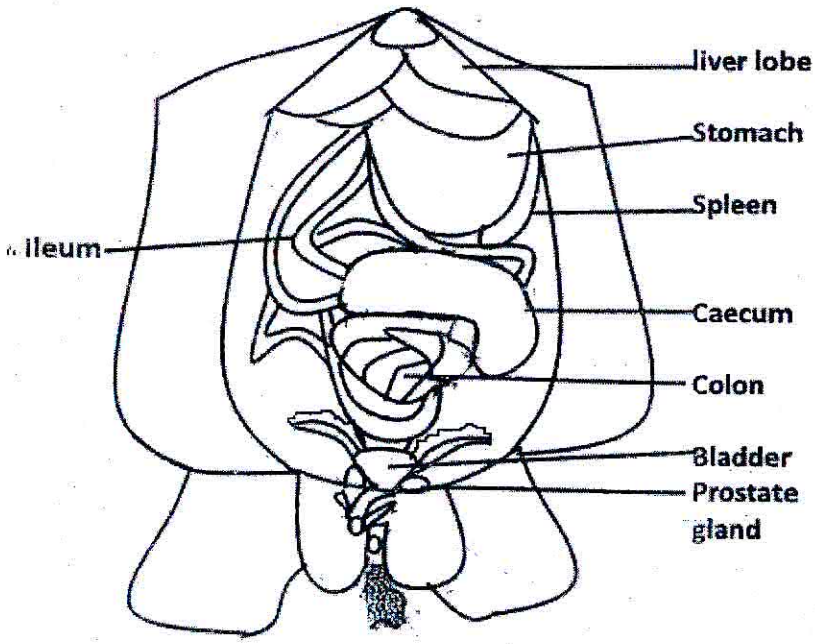


Drawing of the ventral view of the heart and associated blood vessels with lungs removed from the thoracic region



The common body systems studied after opening the animal are the, digestive system, circulatory system, reproductive system and excretory system.

THE ABDOMINAL VISCERA IN UNDISTURBED STATE

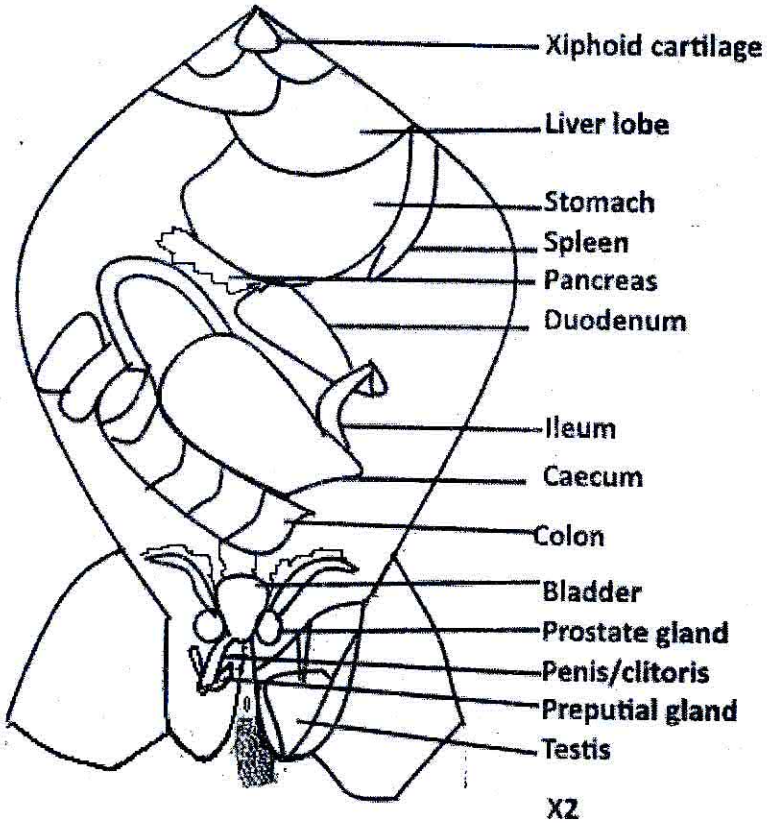


This consists of the alimentary canal and its associated organs.

The alimentary canal:

This shows a greater differentiation into regions than that of lower vertebrates. It consists of the, oesophagus, stomach, duodenum, ileum, caecum, colon and rectum.

Drawing showing structures lying posterior to the diaphragm without displacing any organs of specmen R /RAT



X2

THE OESOPHAGUS

It is a long tube that leads through the neck and thorax to the stomach .it is muscular with smooth inner lining .the smooth lining and contraction of muscular wall ease swallowing .longitudinal folds close the lumen except when swallowing .at the distal end, the muscles constrict to form cardiac sphincter that control flow of food into stomach .

THE STOMACH:

It is an enlarged ovoid sac lying transversely a cross the abdomen beneath the diaphragm which separates the thoracic cavity from the abdominal ,diaphragm is membranous, broad elastic ,and thin (transparent).the stomach is used as;

- A temporary store of food, giving chance for action of enzymes.
- A site of digestion of food.
- A site of absorption of digested food.

The inner lining of the pylorus stomach is folded and smooth .the folds increase the surface area foe digestion and absorption of digested food. The folds also allow extension of the stomach to increase storage. The wall of the pylorus stomach is thick /opaque. The lining of cardiac stomach is smooth, and not folded .the wall of the cardiac stomach is thin and transparent.
The anterior end constricts into **pyloric sphincter** that control empting of chyme.
The stomach wall has many blood capillaries to increase the surface area for absorption of digested food.

DUODENUM
It is a short tubular feature which bends into a V shape. Between its bend lies a membranous pancreas.
The function of the duodenum is used for digestion and absorption of digested food.
Bile ducts from the gall bladder and pancreatic ducts from pancreas open into the duodenum to release bile and pancreatic juices that enhance digestion of Food.

ILEUM
It is a very long greatly coiled tubular organ made up of thin wall. It is greatly attached to by numerous blood capillaries which are tributaries of hepatic portal vein.
It is used for digestion and absorption of digested food. It is adapted to its function by;

- Having numerous blood capillaries to increase surface area for absorption of digested food.
- Having thin wall to reduce diffusion distance of digested food into capillaries.
- Being very long and coiled to increase surface area for digestion and absorption of digested food.

Between the ileum mesentery and colon but so close and along the colon, lays a chain of seven lymph nodes.

CAECUM AND APPENDIX is an extension of the caecum which is between the ileum and the colon.
Both are enlarged and are used for digestion and absorption of food mainly the cellulose.
They contain bacteria that releases cellulase enzyme that can digest cellulose.

COLON
It is short and enlarged .it is used for storage of wastes .it also allows absorption of water i.e. enlarged to increase storage of wastes .it bears capillaries for faster water absorption .

RECTUM
It stores wastes (unwanted materials) and also allows absorption of water to increase water conservation .contraction of rectal muscles removes unwanted materials (faeces) from the body.

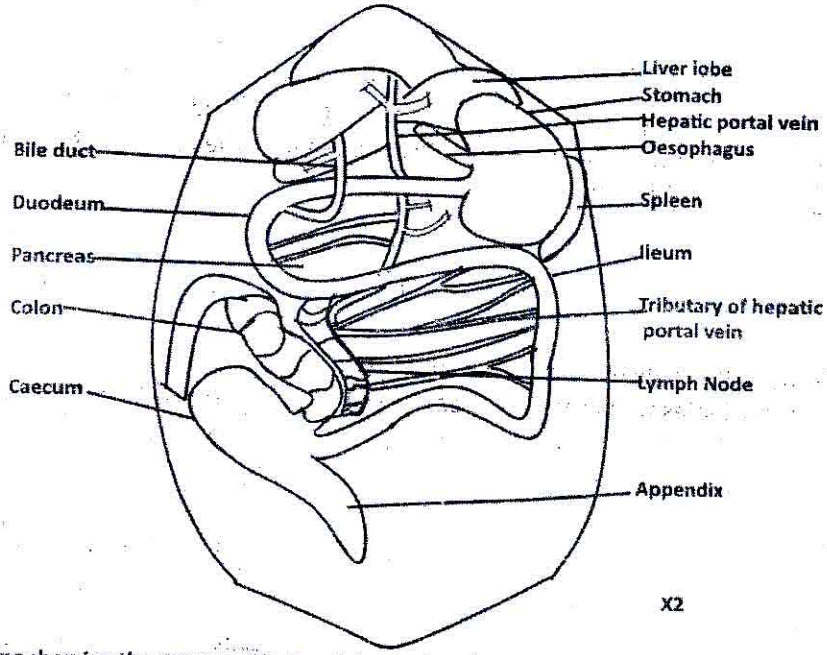
GLANDS ASSOCIATED WITH THE ALIMENTERY CANAL:

THE LIVER
It is the largest gland in the body .it has many functions in the body ,its digestive function is the production of the bile contains bile salts that emulsify fats .it also contains sodium hydrogen carbonates which provide a suitable medium for enzyme activity. It is divided into four (4) lobes, which include two on the right, one in the centre, and one on the left.

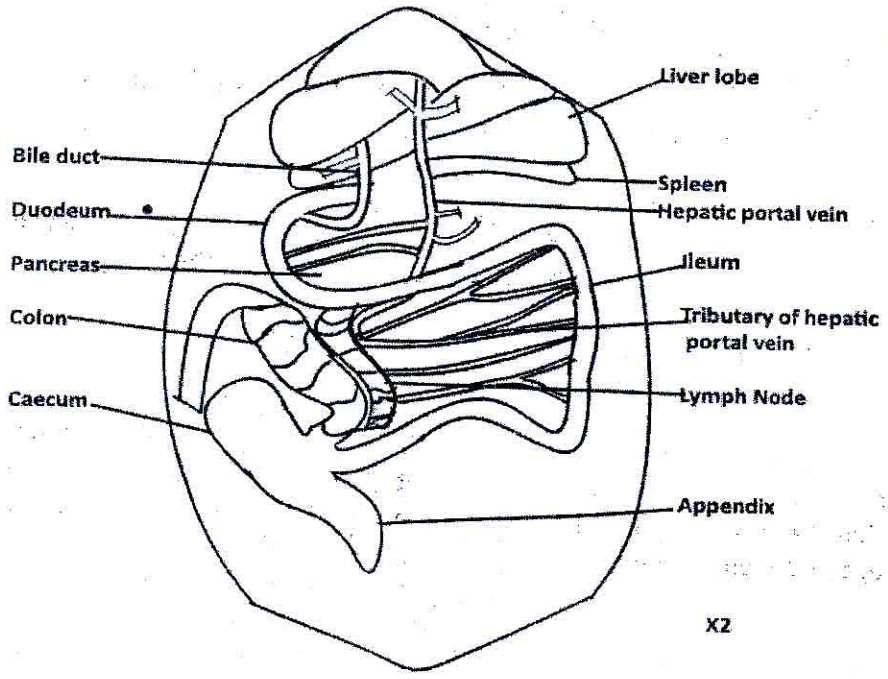
THE PANCREAS

This is endocrine and exocrine organ that appears as small –scattered masses of membranous pink tissue. In the mesentery, between the loops of duodenum, its ducts open into the duodenum, secreting pancreatic juice, which contains enzymes that digest food, together with bicarbonate ions that make the PH suitable for enzymes activity.

Drawing of the alimentary canal and associated organs with the duodenum loop displaced to its right and ileum displaced to its left without destroying the mesenteries



Drawing showing the structures in the abdominal region without the stomach,with duodeum loop displaced to the right, ileum to the left ,colon and rectum downward to the right and libver lobes displaced anteriorly of specimen K/rat

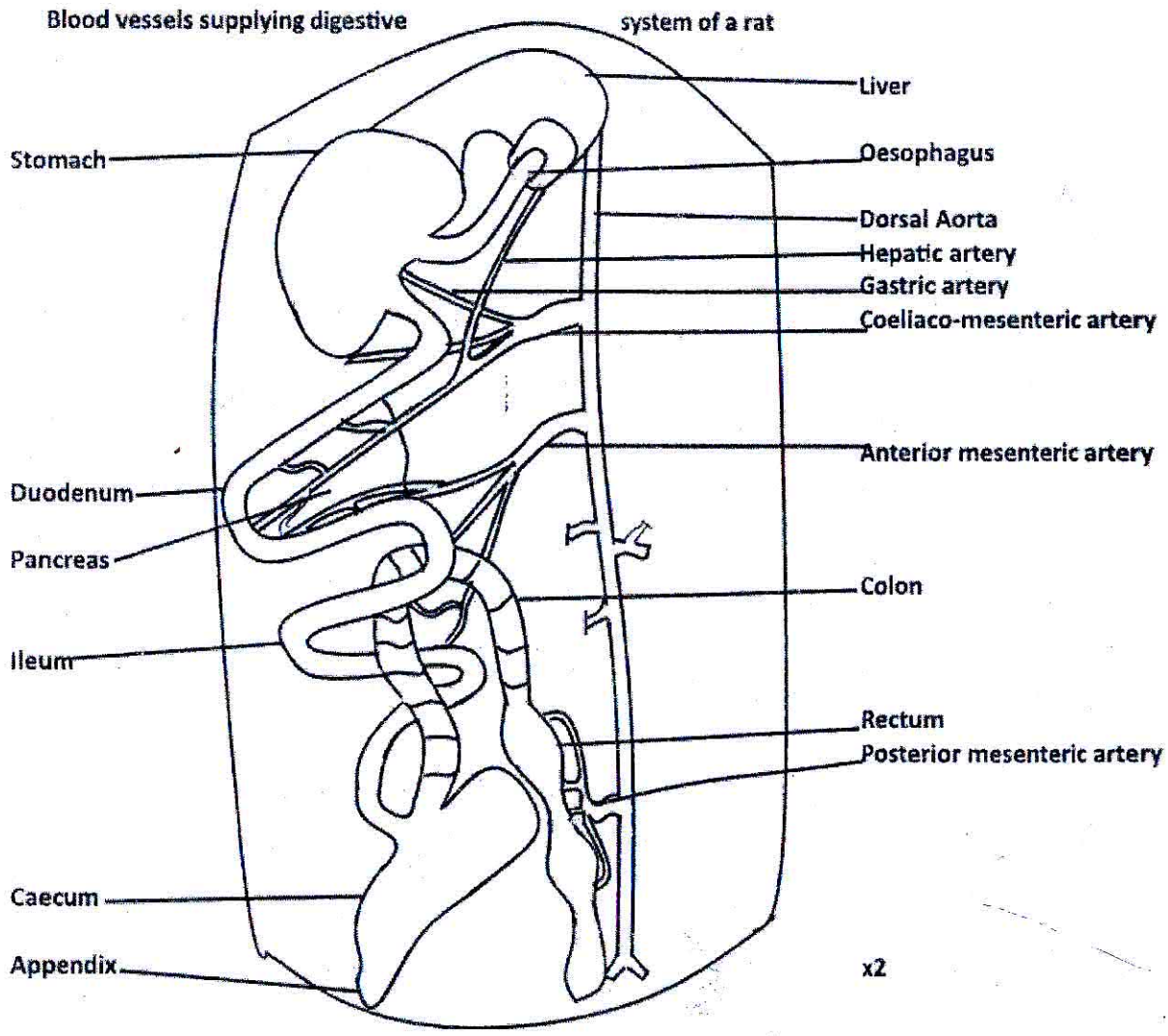


BLOOD VESSELS SUPPLYING THE ALIMENTARY CANAL

The alimentary canal is supplied by **aorta** which branches into the **Coeliac** artery that in turn divided into **hepatic artery** that splits into two vessels, one supply the liver and the other supply the pancreas, duodenum and pyloric stomach.
The middle branch of the **coeliac artery** called ***lienal artery*** divided into two to supply the pylorus stomach and the **spleen.**
The upper branch of the coeliac artery called the **gastric artery** supplies the cardiac Stomach.

NOTE:
The branch of the hepatic artery that supplies the liver passes beneath gastric and **lienal artery**
Anterior mesenteric artery which in turn divides into numerous capillaries supplying the duodenum, the ileum and the caecum
Posterior mesenteric artery which supplies the colon and rectum

Drawing showing blood vessels supplying digestive system of a RAT



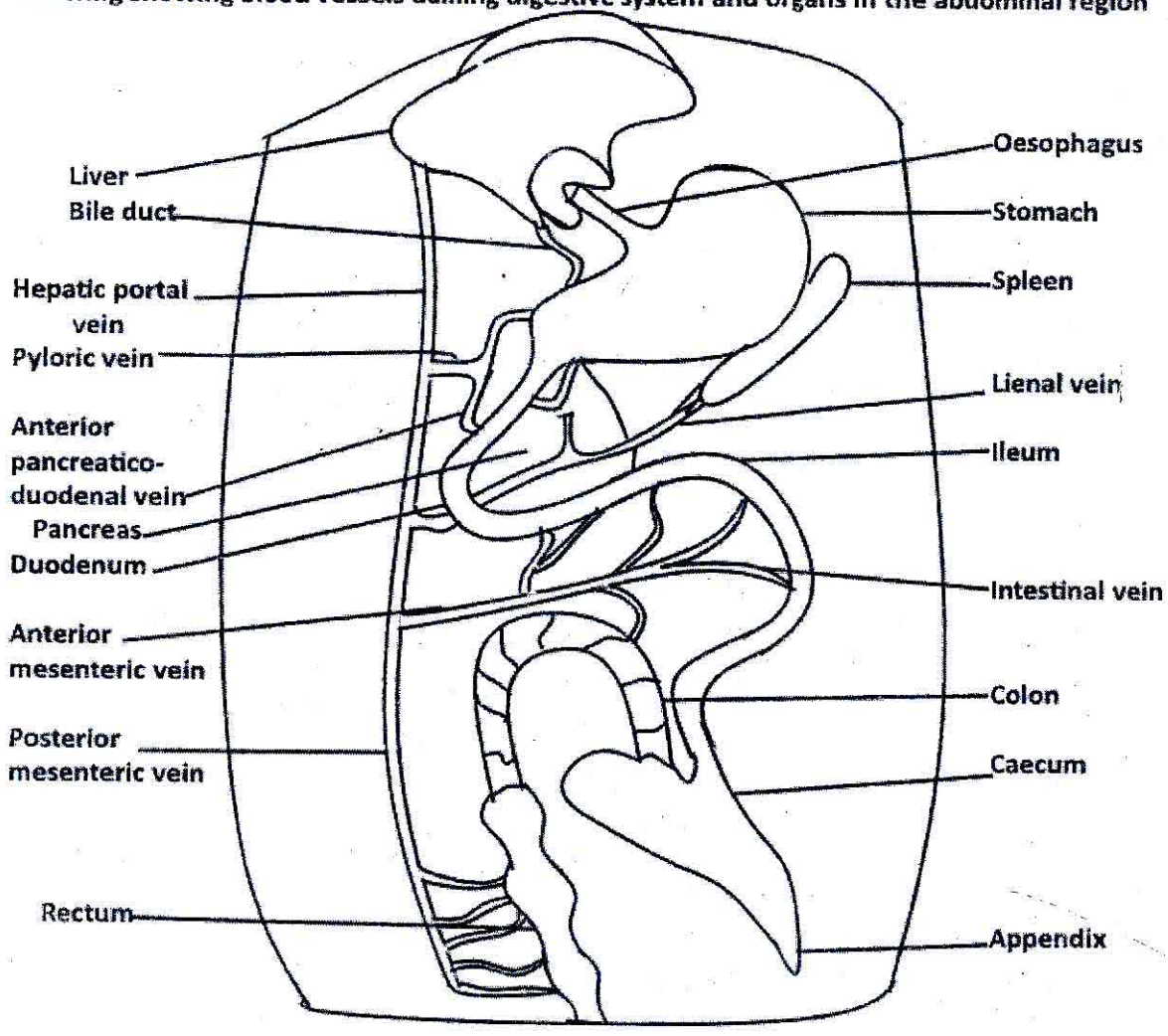
BLOOD VESSELS DRAINING THE ALIMENTARY CANAL

The alimentary canal is drained by main one large vein called **hepatic portal vein** which drains blood from the alimentary canal into the liver .hepatic portal vein branches into;

- Pyloric vein which divides into gastric vein draining the stomach, anterior pancreatico-duodenal vein draining the pancreas and the anterior part of the duodenum.
- **Lienal vein** draining the cardiac stomach and the spleen.
- Posterior mesenteric vein that drains the posterior colon and rectum.
- Posterior pancreatico-duodenal vein that drains the pancreas and the posterior part the duodenum.
- Anterior mesenteric vein draining the ileum, caecum and the anterior part of the duodenum.

Anterior mesenteric vein divides into numerous small capillaries embedded in the mesentery.
The numerous capillaries attached to the ileum increase the surface area for absorption of digested food.

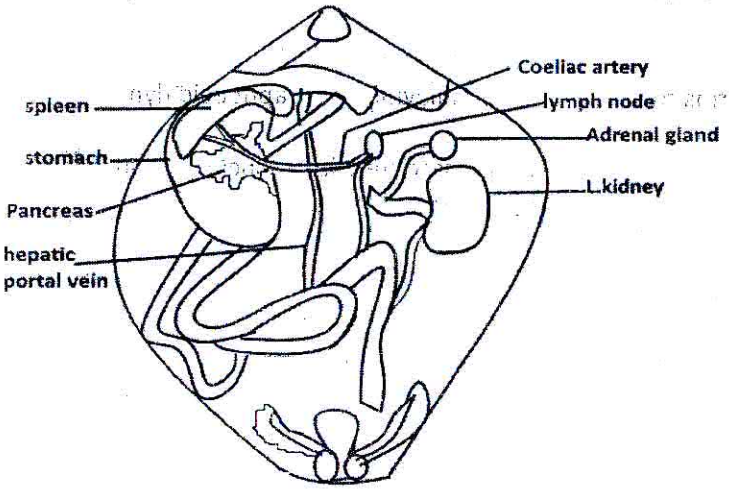
Drawing showing blood vessels daining digestive system and organs in the abdominal region



THE SOLAR PLEXUS

it lies posterior to the **coeliac artery** on the ventral surface of the posterior venacava

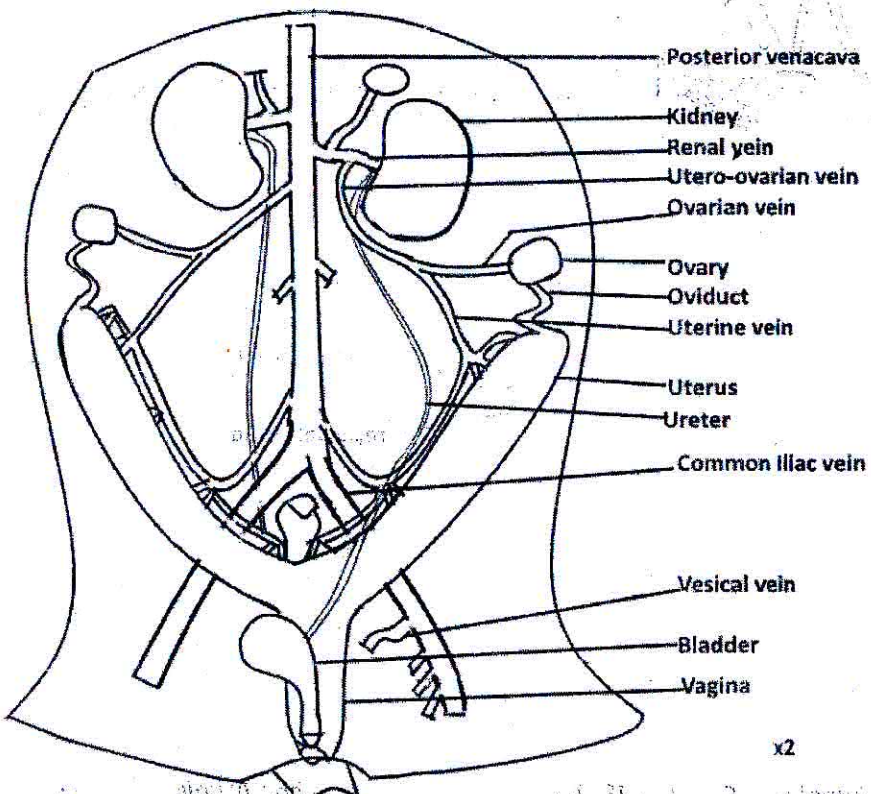
Drawing showing the stomach and the structures previously below it after turning and pulling it to the right of the specimen/rat



FEMALE URINOGENITAL SYSTEM

- **Utero-ovarian artery and vein:**-usually arise from the left renal artery and vein Which forks into the short **Ovarian artery** supplying the Ovary; and the longer **uterine artery** that supplies the uterus
- **Pudendal vessel:** To the pubic area of the pelvis and external genital

Drawing showing blood vessels draining the urinogenital system of a female rat



MALE URINOGENITAL SYSTEM

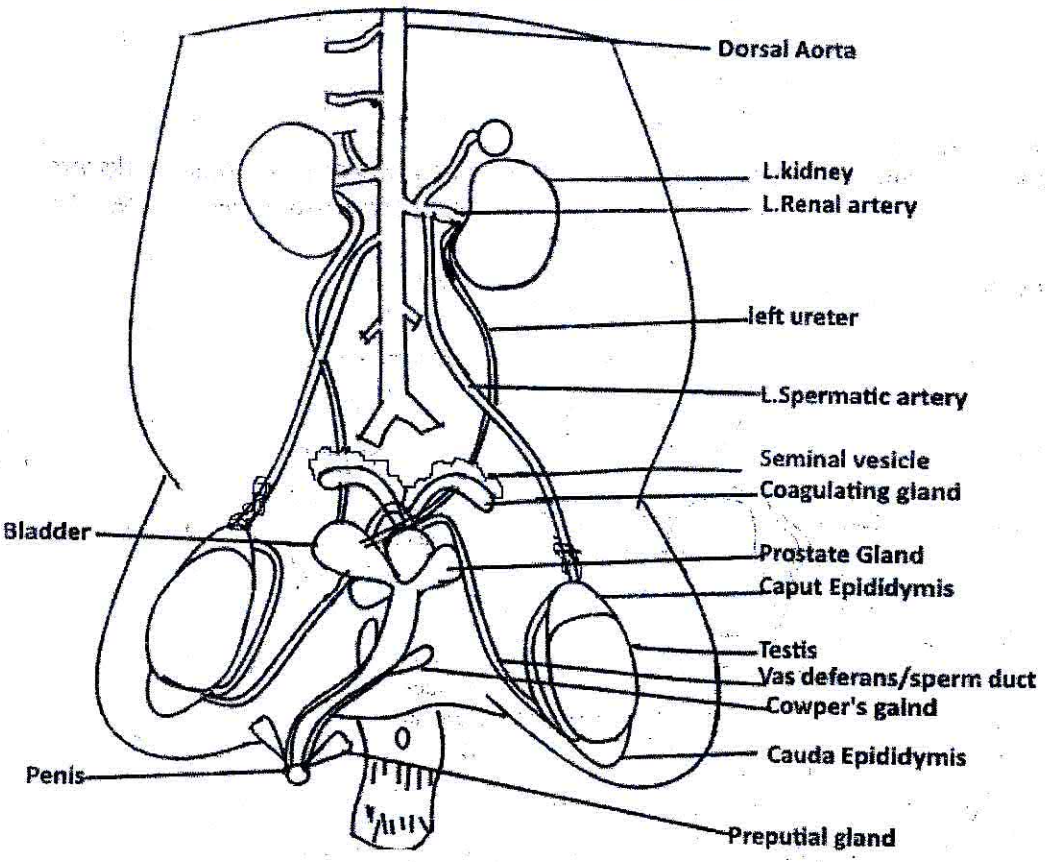
1. Spermatic artery/Testicular artery; Leaves the aorta near the left renal artery and supply's blood to the **testes** while **Spermatic vein** forms an extensive capillary mass around the spermatic artery to drain the testes

2. **Vasa deferentsia.**recieves sperms from the Cauda epididymis and Caput epididymis

3. Seminal vesicle: which are curved structures closely associate with connective tissue called **Coagulating glands**

4. Penis: enclosed by in a sheath of skin, the prepuce. Near the tip of the penis are the **preputial glands**

Drawing showing the Urinogenital system of a Male rat



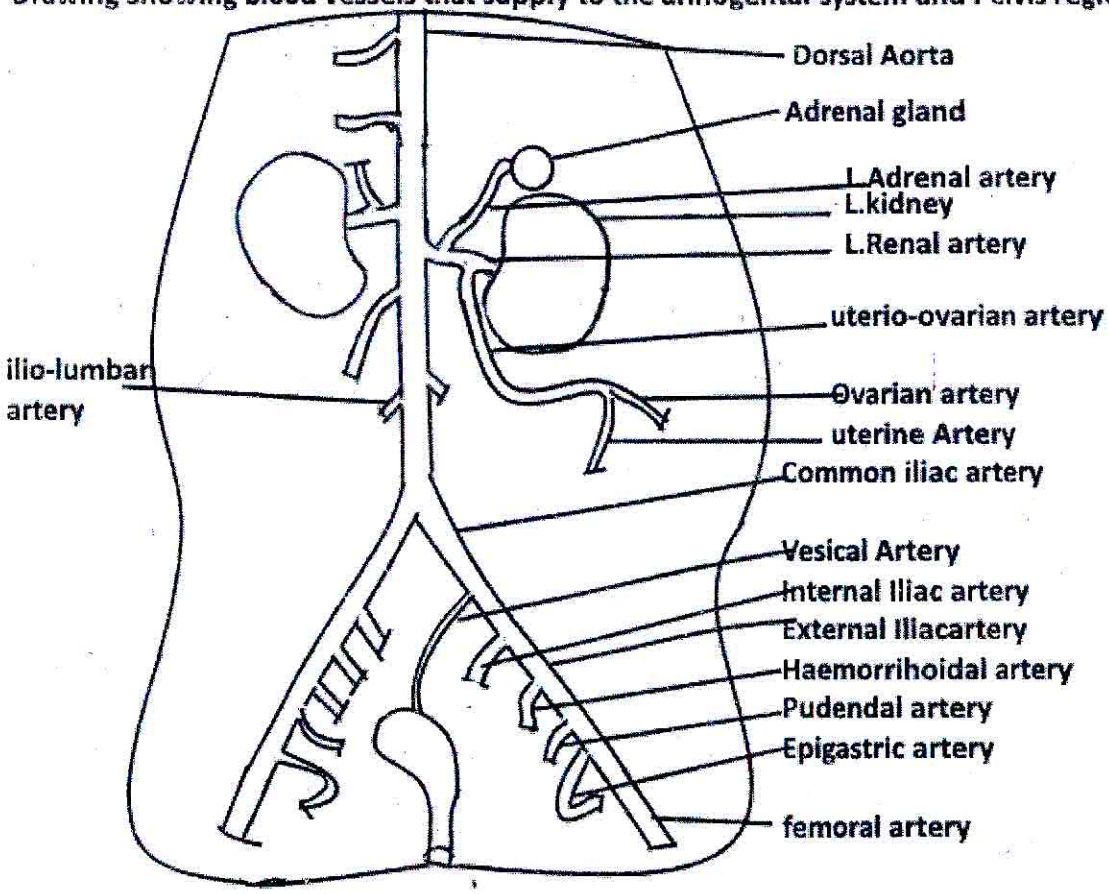
THE VASCULAR SUPPLY TO THE POSTERIOR REGION OF THE BODY

- **Ilio-lumbar artery and vein;**-serving the lumbar muscles and adjacent fat deposits

The dorsal aorta divides terminally into two branches, the **common iliac artery** which gives several branches to supply organs in the groin and hind limb on the respective side the branches include;

- **Vesical artery and vein**-Serve the bladder and the median part of the reproductive system.
- **Internal iliac /hypogastric artery and vein-** To the muscles of dorsal region of the pelvis
- **The external iliac artery**
- **Haemorrhoidal artery and vein**: To the lower rectum and anal region
- **Pudendal artery and vein**,-To the pubic area of the pelvis and external genitalia.
- **Epigastric artery and vein:** Serving the posterior muscles of abdomen.
- **Femoral artery and vein,** which supplies the outer part of the limb (thigh) and continues as politely artery to supply the leg

Drawing showing blood vessels that supply to the urinogental system and Pelvis region



UNEB PAST PAPERS

UACE BIOLGY PAPER 3 2016

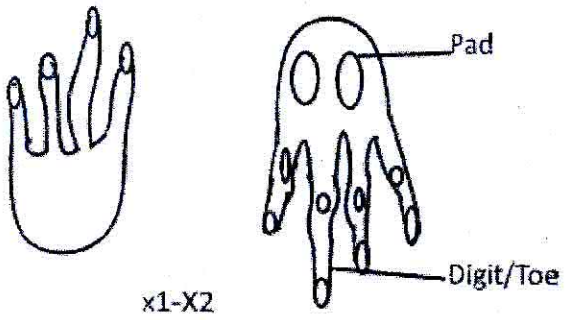
QUESTION 1 **(72 minutes , 43 marks)**

You are provided with specimen **R (TOAD)** which is freshly killed. Examine the fore and hind feet of the specimen.

a) Draw and label the ventral side of the left fore foot and left hind foot of the specimen. Both drawings should be at the same magnification. (07marks)

i) Fore foot

A Drawing showing the ventral side of the left forefoot of specimen R

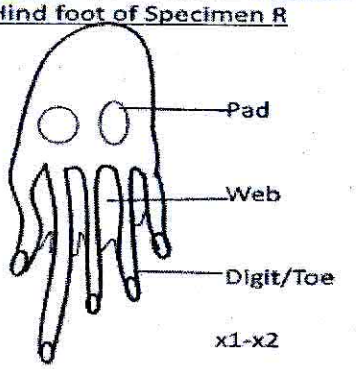


x1-X2

T-0.5
M-0.5
N-0.5
D-01
L-01
A-0.4
T=04

ii) Hind foot

A Drawing showing the ventral side of the left Hind foot of Specimen R

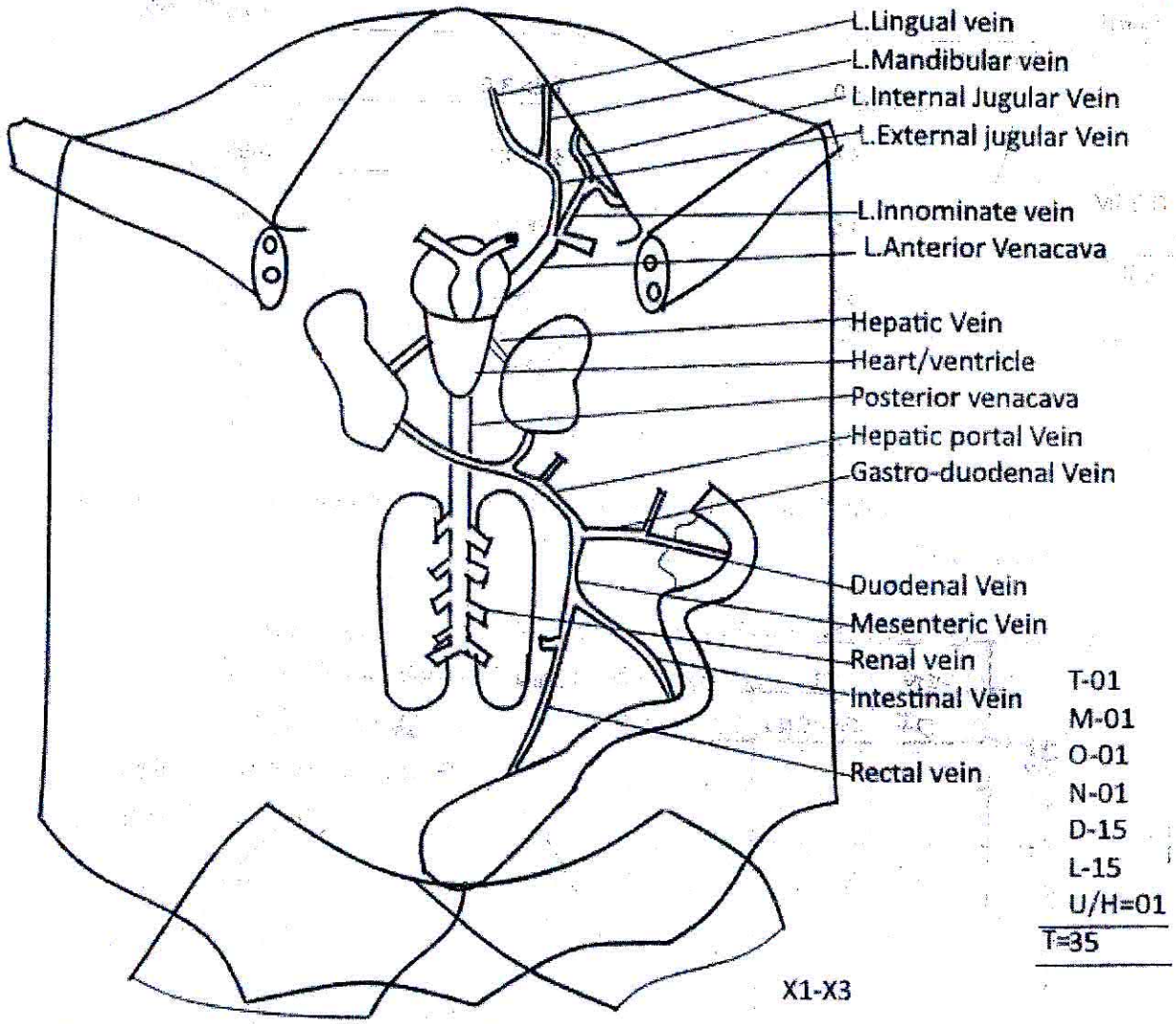


x1-x2

T-0.5
M-0.5
N-0.5
D-1.5
L-1.5
A-0.5
T-04 Max

b) Dissect the specimen to dis[play the heart and the blood vessels that carry blood from the head region, intestines and kidneys and back to the heart. Without displacing the heart, draw and label your dissection. **(36 marks)**

A Drawing showing the blood vessels/veins that carry blood back to the heart from the Head region ,intestines and Kidneys of specimen R with the heart undisplaced



N/A-IF arteries drawn and labeled to intestines and kidney, heart

Question 2 **(1:49 minutes)**

You are provided with specimen **K(Fresh big sized Irish potato)** and sucrose solutions of different concentrations as shown in table 1. Carry out the tests on the specimen using the solutions according to the following instructions

1. Cut long strips out of K using a cork borer **of 0.5cm** in diameter. All strips must be cut along the same axis.
2. From the long strips, cut out six strips each **measuring 3 cm** in length.
3. Place one strip in each of the sucrose solutions ensuring that the strip is immersed.
4. Leave the set-up for 1 hour(you may proceed with other work in the meantime)
5. After 1 hour, remove one strip at a time and measure its final length.

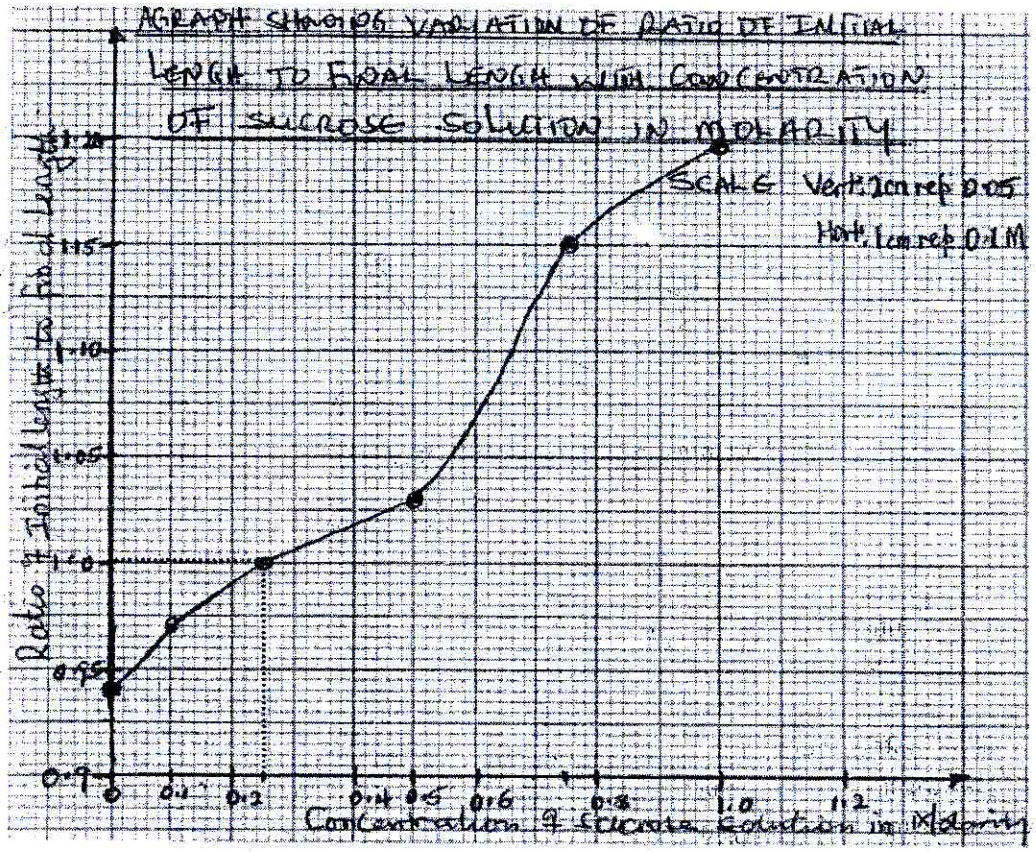
a) Record the measurements appropriately in table 1

b) Complete the table by working out the **initial length: final length ratio** for each piece.

Table 1

Molarity of sucrose solution	**Initial length (cm)**	**Final length (cm)**	**initial length: final length ratio**
0.0M(distilled water)	**3.0**	**3.2> 3.0**	**0.94**
0.1M	**3.0**	**3.1>3.0**	**0.97**
0.25M	**3.0**	**3.0≤ ≥**	**1.0**
0.5M	**3.0**	**2.9<3.0**	**1.03**
0.75M	**3.0**	**2.6<3.0**	**1.15**
1.0M	**3.0**	**2.5**	**1.2**

c) In the space provided, plot a graph of the **initial: final length ratio** against the molarity of the sucrose solution. (09maks)



From your graph,

i) Deduce how turgor pressure and osmotic pressure of the tissue of K varied in the different sucrose solutions **(06marks)**

Turgor pressure was highest at 0.0M and reduced with increasing Molarity/increasing sucrose concentration because highest increase in length/lowest ratio at 0.0 M, Implies highest turgor , because of much water intake by osmosis/endosmosis, osmotic pressure lowest at 0.0 and increased with increasing molarity/increasing sucrose /sugar concentration because highest decrease in length/highest ratio at 1.0 implying cells most plasmolysed, due to excess water loss by osmosis/exosmosis and hence highest osmotic pressure

Or *turgor pressure was lowest at 1.0M and increased with increasing molarity/decreasing sucrose concentration, because of greatest reduction in length/highest ratio, at 1.0m, implies lowest turgor pressure because of much water loss by osmosis/exosmosis. Osmotic pressure was highest at 1.0M and decreased with decreasing molarity/decreasing sucrose because highest increase in length/lowest ratio at 0.0M implying cells most turgid due to much water uptake by osmosis/endosmosis and hence lowest osmotic pressure*

ii) Determine the molarity of sucrose solution that is isotonic to that of the cell sap of **K**. show your working on the graph

Its 0.25, bbecuase the ratio was 1:1 (Check the dotted lines on the graph)

Question 3 **(54 minutes, 30marks)**

P=few Filamentous algae, Spirogyra in water and **Q**=common /rhizopous /mould

You are provided with specimens **P and Q**

a) Mount a small portion of specimen **P** in a drop of water and observe under the low power of a microscope. Classify **P** into kingdom and phylum giving two reasons in each case. **(06marks)**

i) Kingdom: **protoctista.../ plantae** due to possession of cell wall and chloroplast

Reasons

- ***Its Unicelullar/single celled***
- ***Has Numerous identical cells***

ii) Phylum: ***chlorophyta***

Reasons

- ***Possession of Spiral chloroplast***
- ***It is Filamentous/thallus***
- ***Has Septate cells/cells joined end to end***

b) Similarly mount a small portion of specimen **Q** in a drop of water and observe under low power of a microscope. Describe the structure of the main parts of the specimen. **(08marks)**

- ***Sporangium spherical/round, smooth/rough***
- ***Sporangiophore long/enlongated,slender/thin threadlike***

- *Rhizoids/rooting hyphae thin/threadlike, slender/thin*
- *Stolon/linking hyphae thin/slender and branched*

From the structures of specimen P and Q, suggest how each of them is adapted to its habitat.

i). Specimen P (*02marks*)

- *Septate/segmented for easy fragmentation/propagation*
- *Filamentous for easy floatation*
- *Long Spiral chloroplasts for increased surface area for photosynthesis*
- *Thick cell wall for protection/preventing bursting*
- *Filamentous for easy diffusion of nutrients/materials*

ii) Specimen Q (04marks)

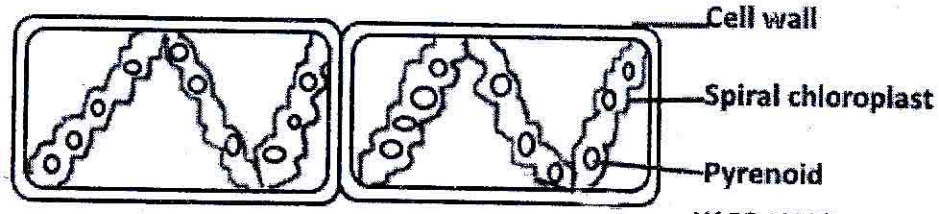
- *Long sporangiophore to expose sporangium for spore dispersal*
- *Thin/slender sporangiophore for flexibility to increase chances of spore dispersal*
- *Large/swollen sporangium to store/produce many spores to increase chances of reproduction/propagation*
- *Numerous rhizoids for anchorage/food absorption*
- *Thin/pointed tip of rhizoids for easy penetration into substratum*
- *Many stolons for faster colonization/propagation*

a) From your observation of specimen Q suggest the limitations that the specimen faces in the a terrestrial environment. (02 marks)

- *Thin so easy loss of water*
- *Lacks protective structures against water loss*

b) Draw and label two adjacent cells of specimen P which can be seen clearly under the medium power of a microscope. (08marks)

Drawing of two adjacent cells of specimen P as seen under medium power of a microscope



X100-X600

UACE BIOLGY PAPER 3 2015

Question 1 **(68minutes)**

You are provided with specimen **K (freshly killed TOAD)** which is fleshly killed.

a) I) Measure the length of the fore and hind limbs and record the results in table 1. Express the results as a ratio of length of fore limb : length of hind limb

Table 1

Length (mm)	**Fore limb**	**Hind limb**
	20-55	**40-130**
Ratio	**1 : 2**	

ii) State the significance of the ratio **(01 mark)**

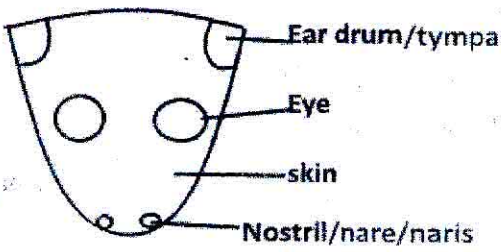
The hind limb is twice as long/longer than the fore limb to generate propulsive force for swimming/leaping/hopping/locomotion
Fore limb is shorter/half the length of the hind limb to absorb shock on landing/during hopping/locomotion

b) Examine the hind limb and state three ways it is adapted for the survival of the specimen in its habitat. ***(03 marks)***

- *long/muscular to generate propulsive forward thrust for swimming/hopping/locomotion*
- *webbed toes/digits to ease swimming*
- *jointed digits/limbs for flexibility*
- *dull coloured for camouflage/brown/black patches for camouflage*
- *long digits to increase grip during locomotion*
- *moist skin for gaseous exchange*
- *numerous mucus glands/swellings to secrete mucus to moisten the skin for gaseous exchange*
- *numerous/many poison glands/swellings which secrete poison for defence*

c) Examine the head of the specimen and draw and label the dorsal view of the anterior part of the head to show the structures for sensitivity. **(05 marks)**

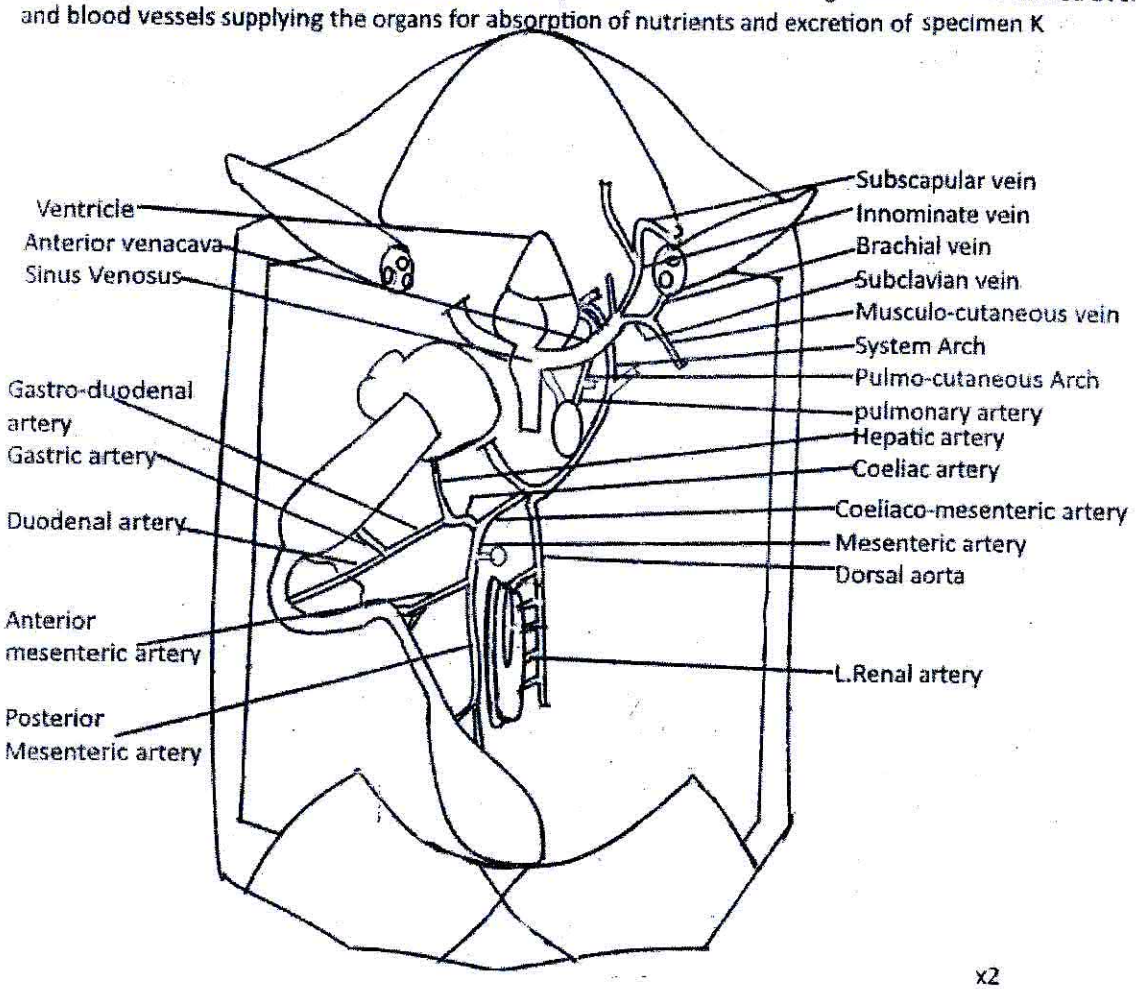
Drawing of the dorsal view of the anterior part of the head showing structures fo sensitivity of specimen K



T-0.5
M-0.5
O-0.5
N-0.5
DL-04
T=06

d) Dissect the specimen to expose the heart. Turn the heart over to display the main blood vessels
i) Returning blood from the trunk region to the heart.
ii) Supplying the structures for absorption of nutrients and excretory organs.
Draw and **label** **(27 marks)**

Drawing showing the main blood vessels returning blood from the trunk region to the heart turned over and blood vessels supplying the organs for absorption of nutrients and excretion of specimen K



x2

Question 2 ***(34 marks, 56 minutes)***

Solution D= 2% sucrose solution, E= 1 % starch solution, 2%yeast solution, Solution Y= 2M HCl

You are provided with solutions **D; E and X**. You are required to carry out the test on the solution **D and E** and then investigate the action **X on D and E.**

a) Carry out tests in table 2 to determine the food nutrients in solutions **D and E**. Record your test procedure, observations and conclusions in table 2 below **(12 marks)**

Table 1

Test	solutions	Observations	Deductions
Benedict's test To ***1/2cm^3*** of solution ***D /E*** was added ***1/2cm^3***	D	*The colourless solution turned pale blue solution; which persisted on boiling/green solution*	***Reducing sugars absent/little reducing sugars present***

of ***Benedict's Solution*** and ***boil***ed	E	*The turbid solution turned pale blue solution; which on boiling remains pale blue*	***Reducing sugars absent,***
Iodine test *To **1/2cm³** of solution **E;D** was added **1/2/3 drops** of **iodine solution***	D	*The colourless solution turned pale brown solution/yellow;*	***Starch absent;***
	E	*The turbid suspension turns to blue-black solution/black solution;*	***Much , starch present;***

b) Label **FOUR** test tubes as **1;2 ;3 and 4** add contents to each test tube as shown in table 3

Table 3

Test tube	**Contents**
Test tube 1	1cm³ of solution **X** +3 cm³ of solution **D**
Test tube 2	1cm³ of solution **X**+ 3 cm³ of solution **E**
Test tube 3	1cm³ of solution **X** + 5 cm³ of solution **D+ 1 cm³** of Solution **Y**
Test tube 4	1cm³ of solution **X**+ 3cm³ of solution **E + 1 cm³** of Solution **Y**

b) Incubate all the test tubes for 30 minutes in a water bath maintained at **37-40 °C** (meanwhile continue with other tasks) shaking periodically.

After **30 minutes;** divide the contents of each test tube into two and carry out iodine test and Benedict's tests as shown in table in table 4. Record your observations and deductions in the table below. **(16marks)**

Table 4

Test tube	**Test**	**Observations**	**Deductions**
1	Iodine test	*The turbid solution turned pale brown solution/yellow*	***Starch absent***
	Benedict's test	*The turbid solution turned pale blue solution; which on boiling turned to ,green solution, then to yellow ppt/orange ppt*	***Much reducing sugars present***
2	Iodine test	*The turbid suspension turns to pale blue-black solution/pale purple/purple solution;*	***Little/moderate reducing sugars present***
	Benedict's test	*The turbid solution turned pale blue solution; which on boiling turned to ,green solution*	***Little reducing sugars present***
3	Iodine test	*The turbid solution turned pale brown solution/yellow solution*	***Starch absent***

	Benedict's test	*The turbid solution turned pale blue solution; which on boiling turned to ,green solution/ yellow ppt*	***Little/moderate reducing sugars present***
4	Iodine test	*The turbid solution turned blue-black solution/purple/pale black solution*	***Moderate/much starch present***
	Benedict's test	*The turbid solution turned pale blue solution; which on boiling remains pale blue*	***Reducing sugars absent***

c) From your results, state the nature of solution **X and Y** giving reasons for your answer.

i) **X** ***enzyme*** **(03marks)**

*Contains an **active substance/enzyme** that catalysed the breakdown/hydrolysis of food substance in solution D to reducing sugars*
It catalysed the breakdown of solution D to reducing sugars and starch which is reduced in quantity/breas down solution D more than starch/it is specific in that it hydrolysed/catalysed the breakdown of solution D but not starch
Its activity is inhibited by solution Y as there is less hydrolysis/activity in presence of solution Y

i) **Y** ***inhibitor*** **(01mark)**

*It is an **inhibitor** because it reduces the activity of solution X in test tube 3*

Question 3 **(56 MINUTES)**

You are provided with specimens **P; Q; R and S.**

a) Examine them and state the phylum of each specimen giving a reason in each case. (08marks)

Specimen	Phylum	Reason
P spirogyra	***Chlorophyta***	***Septate filaments/filamentous with green pigments/spiral chloroplast/filamentous body***
Q Mould	***Zygomycota***	***Sporangiophore/vertical hyphae/stalk with round sporangium*** ***Network of branching hyphae/mycelium/stolon/horizontal hyphae***
R Moss	***Bryophyta***	***Spirally arranged leaflike structures/simple leaves /false leves*** ***Body differentiated into simple leaves and stem attached to gametophyte anchored by rhizoids*** ***Spore bearing capsule/sporangium at the end of the seta/stalk***
S Amaranthus	***Angiospermophyta/ tracheophyta/ spermatophyta***	***Body differentiated into roots, stems and leaves*** ***Presence of flowers*** ***Presence of vascular bundles***

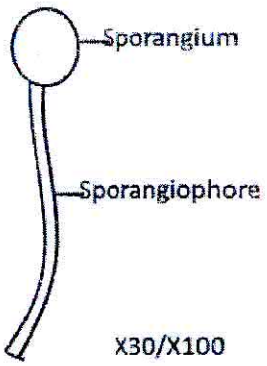
b) Obtain a unit of P mount it in water on a slide and observe under medium power of a microscope.

State how the specimen is adapted for nutrition **(01mark)**

- *Spiral chloroplast tp increase surface area for absorption/trapping of sunlight for photosynthesis;*
- *Green pigment/chlorophyll for absorption of sun light;*
- *Circular Pyrenoids for storage of food;*

c) i) Isolate on functional unit of **specimen Q** growing vertically. Put it on a slide and observe under medium power of a microscope. Draw and **label** **(04marks)**

Drawing of one functional vertically growing unit of Specimen Q



T-0.5
M-0.5
O-0.5
N-0.5
D-01
L-01
T=04

ii) Dust particles of Q fro the tips of vertically growing structures onto a slide. Observe under medium power of a microscope. From the structures of q explain how it is adapted for propagation. **(03marks)**

- *Long sporangiophore/vertical/hyphae to expose the sporangia for easy dispersal of spores;*
- *Thin/slender sporangiophore to be easily shaken to disperse the spores ;*
- *Swollen/large sporangia to produce/store a lot of/large quantities of spores to increase chances of propagation;*
- *Numerous sporangia to store many spores for propagation/to produce large amounts of spores to increase chances of dispersal/colonization;*

d i) examine **specimen R** and suggest its habitat. **(01 mark)**

Moist/damp/damp shaded terrestrial soil/tree trunks/walls of houses/buildings

ii) Isolate one unit of **R** and examine it. State how the specimen is adapted for survival in the habitat stated in (d) (i). **(04marks)**

- *It has numerous rhizoids for anchorage and absorption of water from substratum*
- *It has a large /swollen spore capsule to produce numerous spores* ***allow quick colonization of sporophyte on the land.***
- *Has long seta/stalk to raise the spore capsule high for easy dispersal of spores*
- ***Has spirally leaves to increase surface area/exposure to sunlight for photosynthesis.***
- ***Numerous leaves to increase surface area for light absorption***

- *Thin rhizoids to ease absorption of nutrients*
- *Large/swollen sporangium to store many spores*
- *Erect stem to expose leaves for photosynthesis*
- *Erect/upright seta to expose sporangium for easy dispersal of spores*
- *Thin seta for easy swing for dispersal of spores*

e i) examine **specimen S** and state the class of plant it belongs to **(01mark)**

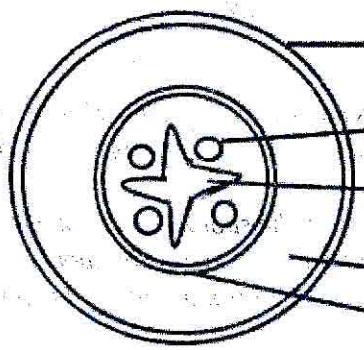
Dicotyledoneae/Angiospermae

ii) Give three descriptive features of **specimen S** which qualify it to be in the class stated in e (I**(03marks)**

- *leaves with net work veins ;*
- *Presence of one main root with numerous lateral branches which is tapering and long;*
- *Leaves with broad/large lamina;*
- *Leaves attached to stem by solid long stalk*
- *Star arrangement of xylem tissues in whose arms are the phloem tissue;*

f) Cut a thin transverse section of the main root of specimen S .place it onto a slide and observe under low power of a microscope. Draw and label a plan to show the arrangement of tissues. **(05marks)**

Drawing of transverse section of root of specimen S
Showing arrangement of tissue plan



x25-x100

T-0.5
M-0.5
O-0.5
N-0.5
D-02
L-02
T=06

UACE BIOLGY PAPER 3 2014

QUESTION 1 (63 MINUTES)

You are provided with specimen **G (cockroach)** which is freshly killed

a) Using a hand lens examine the antennae and hind limbs of the specimen and state how they are adapted to the habitat of the specimen.

i) **Antennae.** **(02 marks)**

- *Long to feel/sense at long distance/a distance.*
- *Segmented /jointed for flexibility/to ease movement*
- *Thin/slender to ease movement*

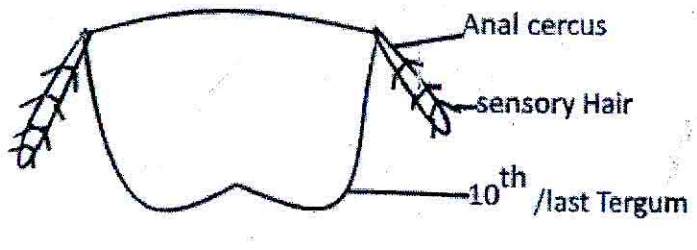
ii) **Hind limbs** **(02marks)**

- *Jointed for flexibility*
- *Pointed spines for defence/protection against enemies*
- *Pointed spines to increase grip*
- *Pointed/curved claws for grip on rough surfaces*
- *Plantulae/arolium/glandular pad for secretion of adhesive/sticky substance for grip on slippery/smooth surfaces.*
- *Dull coloured for camouflage*
- *Broad/large coxae for generation of propulsive force/for locomotion*
- *Long femur/tibia to generate propulsive force/for locomotion/movement*

b) Examine the last tergum of the specimen from the ventral view.

i) Draw and label **(06marks)**

Drawing of the structures on the ventral side of the last Tergum of specimen G



X2-X5

T-0.5
M-0.5
O-0.5
N-0.5
D-1.5
L-1.5
T=05

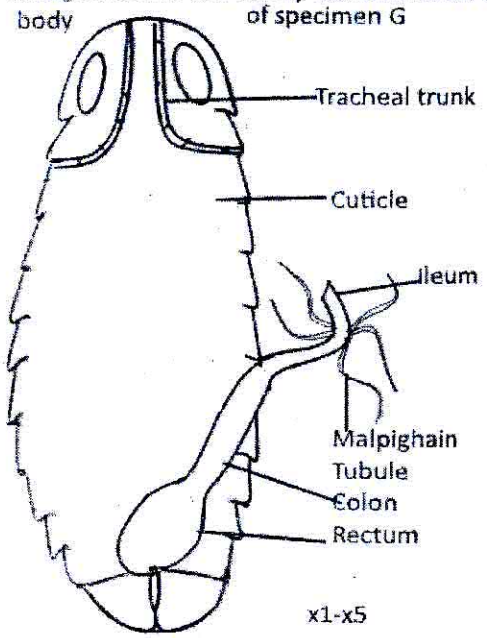
ii) Giving reasons, state the sex of the specimen **(01mark)**

Sex: Male	**OR Female**
Has a narrow abdomen	*Has a broader abdomen.*
Has a pair of styles	*Has podical plates/podical opening/ovipositor/oothecal chamber*
Has pointed male gonapophyses	*has blunt/round ended female gonapophyses*

c) With the dorsal side uppermost, dissect the specimen to display the structures used for the removal of undigested and excretory materials from the specimens' body.

Draw and label **(10 marks)**

Drawing showing structures for removal of undigested and excretaory materials from the body of specimen G

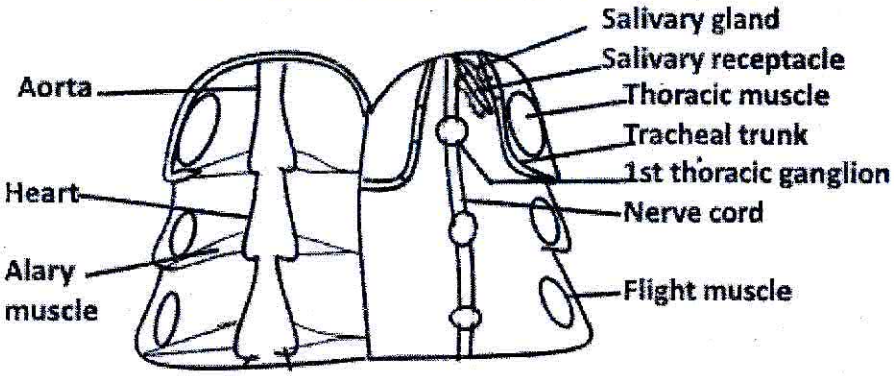


x1-x5

T-0.5
M-0.5
O-0.5
N-0.5
D-03
L-03
T=08

d) Cut out the gut and remove unnecessary tissues to display the structures in the thoracic region. Deflect the dorsal cuticle to the left.Draw and label. **(14 marks)**

Drawing showing structures on the dorsal and ventral cuticles of specimen G with the gut/alimentary canal removed /cut out.



x2-x5

T-01
M-01
O-01
N-01
D=05
L-05
A-01
T-15

QUESTION 2 (68 MINUTES) **(C=Mixture of 1% starch+1%Egg white, D=undiluted pineapple juice)**

You are provided with solution **C** and an extract **D** from a plant organ.
a) Carry out tests on solutions as indicated in **table 1**.Record your tests, observations and deductions in table 1 below. (20 marks)
Table 1

TEST	solution	OBSERVATIONS	DEDUCTIONS
Starch test *To 1cm³; of **C/D** add 1/2/3 drops; of iodine solution;*	C	Turbid solution/ suspension turned to black/blue-black solution	Much /moderate starch present
	D	Turbid/yellow/pale yellow; solution/suspension turned to pale brown/intense yellow/pale yellow	Starch absent
Benedict's test *To 1 cm³ ;of **C/D** add 1 cm³ ;of Benedict's solution; and boil;*	C	Turbid solution/suspension turned to pale blue/blue/purple solution	Reducing sugars absent
	D	Yellow solution turned to pale blue solution to green solution then to yellow ppt;/orange/brown ppt	Much reducing sugars
Biuret test: *To **1 cm³**; of **C/D** add **1cm³**; of **sodium hydroxide solution;** then **1/2/3 drops** ;of copper (ii) sulphate solution;*	C	Turbid solution/suspension turned to pale blue solution then to deep/intense purple solution	Much proteins present
	D	yellow solution turned to pale/ faint purple solution	Trace/little proteins
DCPIP test *To 1 **/ 2 cm³** ; of **DCPIP solution;** in the test tube add solution C/D **drop wise;** until in excess*	C	Blue solution; turned to pale /faint blue solution.	Vitamin C absent
	D	Blue solution turned to pink solution/ colourless solution/turbid solution	Moderate/Much vitamin C present

b) Label the **FOUR** test tube **as 1,2,3 and 4** and put contents in each test tube as indicated in table 2.

Table 2

Test tube	Contents
1	2 cm^3 of **C** and 2 cm^3 of **D**
2	2 cm^3 of **C** and 1 cm^3 of **D** and 1 cm^3 of dil HCl
3	2 cm^3 of **C** and 2 cm^3 of **D** and 1 cm^3 of dil NaOH
4	2 cm^3 of **C** and 2 cm^3 of boiled and cooled **D**

Incubate the test tubes in the same water bath maintained 37-40°C for $1^1/_2$ hour *(you may continue with other in the meantime)*

After $1^1/_2$ hours, carry out tests in **table 3** and record your observations and deductions in the table.

Table 3

TEST	OBSERVATIONS	DEDUCTIONS
i) Divide contents in test tube **1** into four portions. On the 1st portion, carry out an iodine test	*Turbid solution/ suspension turned to pale black/pale blue-black solution/purple solution*	moderate starch present
ii) on the 2st portion, carry out a Benedict's test	*Turbid solution turned to pale blue solution to green solution then to yellow ppt;/orange/brown ppt*	**Much/moderate reducing sugars**
iii) on the 3st portion, carry out a Biuret test	*Turbid solution turned to very pale blue solution to pale/ faint purple solution*	**Trace/little proteins present**
iv) on the 2st portion, carry	*Blue solution turned to pink*	**moderate / Much vitamin C**

out a DCPIP test	*solution/ colourless solution/turbid solution*	**present**
V) carry out a Biuret test on contents of test tube 2	*Turbid solution turned to pale/faint blue solution to very pale/very faint purple solution*	**Traces/little proteins present**
VI) Repeat test (V) using contents of test tube **3**	*Turbid solution turned to pale blue solution to very very pale solution to pale/faint purple/pale purple solution*	**Traces/little proteins present**
VII) Divide contents test tube **4** into **2** portions. Carry out a biuret test on the 1st portion	*Turned to pale blue solution to deep/intense purple/purple solution;*	**Much/moderate proteins present**
viii) Carry out a DCPIP test on the 1st portion.	*Deep blue solution turned to pink/colourless/turbid/yellow/pale yellow solution;*	**Little/moderate/much vitamin C present**

Explain your results in table 3 **(04marks)**

*Active substance/enzymes/chemical substance/organic/biological catalyst in solution **D** catalysed the break down/hydrolyses of starch; /does not hydrolyse starch but breaks down proteins;*
*Active substance in solution **D** is more active in acidic and alkaline medium and less active in neutral medium;*
*Activity of active substance in solution **D** is stopped/slowed down b boiling/high temperatures denatures the active substance in solution **D**;*
*Boiling breaks down/decomposes vitamin **C** in solution **D***

From your results, state the nature of extract **D** **(02 MARKS)**
Solution D contains enzymes/organic catalyst/biological catalyst that catalysed the break down/hydrolyses protein/proteolytic enzyme and slightly breaks down starch;;

QUESTION 3
(B_1 (bread mould); B_2 (mushroom); B_3 (lichens); B_4 (moss) and B_5(Fern))

You are provided with specimens **B_1, B_2, B_3, B_4 and B_5.**

a) Cut specimen B_2 longitudinally and using a hand lens where necessary, examine specimens **B_2** and **B_5.**
b) Using structural features, state the kingdoms of **B_2 and B_5**. Give a reason for your answer in each case. **(02marks)**

Kingdom of specimen **B_2** : ***Fungi;***
Reason: *Body made up of (fine) filaments/hyphae;*

Kingdom of specimen **B_5**: ***Plantae;*** **(02marks)**

Reason: *body differentiated into roots; stem and leaf like structures;*

b) i) using a hand lens, observe specimen **B $_1$** and describe its structure. **(02marks)**

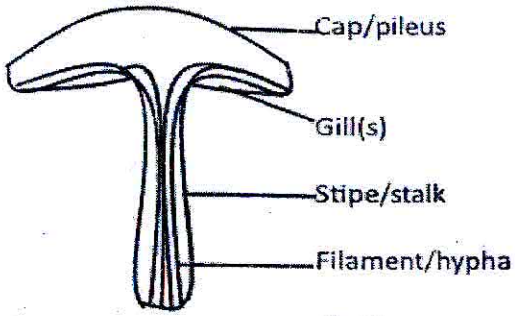
Body made up of mesh work/network; of fine/thin slender; long/elongated filaments/hyphae/fibres; some upright/vertical/sporangiophore; others horizontal/stolon; vertical hyphae/upright/sporangiophore with spherical/round /swollen/large structure/sporangia; at their tips;

ii) From its structure explain how specimen **B_1** is adapted to its mode of life in its habitat. **(02marks)**

- *Long sporangiophore/vertical/hyphae to expose the sporangia for easy dispersal of spores;*
- *Swollen/large sporangia to produce/store a lot of/large quantities of spores;*
- *Numerous sporangia to produce large amounts of spores;*
- *Many horizontal filaments/hyphae/stolons to spread out for easy colonization;/nutrition;*

c) Using a handlens, observe the cut surface of specimen **B_2**.draw and label **(05marks)**

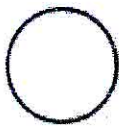
Drawing showing the longitudinal section of specimen B_2



x1-x5

T-0.5
m-0.5
O-0.5
N-0.5
D-1.5
L-1.5
T=05

d) i) Dust some spores from specimen **B $_1$** on a microscope slide. Observe under high power of a microscope. Draw one spore but do not label. **($1^1/_2$ marks)**



Round- 0.5
smooth surface-0.5
Neatness -0.5
Total =1.5

ii) Dust some spores from the lower surface of the leaf front of specimen **B $_5$** on a microscope slide. Observe under high power of a microscope. Draw one spore but do not label. **($1^1/_2$ marks)**

Round -0.5
rough -0.5
Neatness-0.5
Total -1.5

iii) State two differences between the spores of **B_1 and B_5** (02marks)

B_1	B_5
1) Smallerin size	*larger/bigger in size*
2) Has smooth surface	*Has rough surface*
3) dull/brightly coloured	*brightly/dull coloured*
4) round	*oval*

e) State one advantage which specimen **B_3 has over B_1** for survival. (01 marks)

B_3 has green colour/green patches/chlorophyll to carry out photosynthesis

f)i) In the table 4, write the major structural distinguishing features of specimens **B_1, B_2, B_3, B_4 and B_5.**

TABLE 4

specimen	Distinguishing features
B_1 (bread mould)	*Mesh work/network of fine/thin filaments/hyphae;* *Vertical/upright hyphae with spherical bodies/sporangia;* *Has rhizoids;* *Has horizontal hyphae/filaments/hyphae;*
B_2(mushroom);	*Has large cap/pileus; with numerous gills;/lamella* *Has a stalk/stipe; body made up of fine filaments/hyphae; with rooting hyphae/rhizomorpus/rhizoids; sheet like structures under the cap/lamella;*
B_3(lichens)	*Crustose/crust-like /flattened body; undifferentiated body; has hyphae/filaments/rhizoids; lobed;/regulary shaped*
B_4(moss)	*Differentiated into roots; stem and leaf;-like structures/ lamina/ leaves pointed at the apex; long stalk/seta; bearing spore capsule/sporangium at the end; numerous; slender root-like rhizoids; leaves spirally arranged/rosette arrangement.*
B_5(Fern)	*Differentiated into adventitious roots/rhizome; leaves/fronds; lamina divided into leaflets/pinna with pinnules;* *Lower surface has sori/group of sporangia;*

ii) Using the features in table 4, construct a dichotomous key to identify the specimens. **(04marks)**

1a Body differentiated into roots, stem and leaf like structures..... 2
1b Body not differentiated into roots, stem and leaf-like structures 3
2a lamina divided into leaflets.....B_5
2b lamina not divided ..... B_4
3a body crust-like/flattened.....B_3
3b body not crust-like/flattened..... go to 4
4a has a large cap at the tip.....B_2
4bhas a sporangium at the tip.....B_1

END

UACE BIOLGY PAPER 3 2013

Question 1

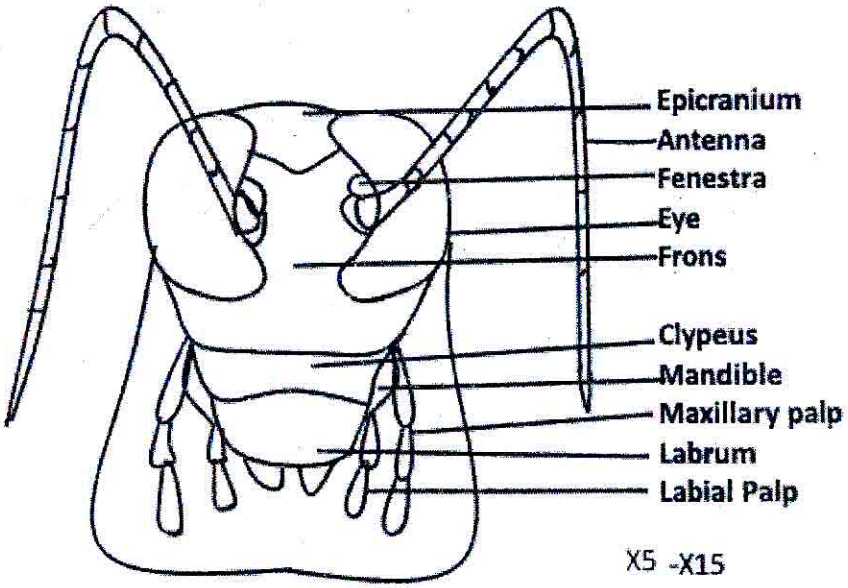
You are provided with specimen **K. (cockroach)**

A) i) With the help of a hand lens, examine the head of the specimen. Using any four observable features on the head, explain how each of them enables the animal to survive in its habitat. **(04mks)**

- *Antennae segmental/jointed for flexibility/easy swinging/more in all direction*
- *Tapering antennae to easily swing in all directions*
- *Serrated/toothed edge to increase surface area for crushing food*
- *Compound eyes which are Large/protruding/curved outwards for wide field of view*
- *Long antennae to feel at a distance*
- *Labrum curved to prevent food from falling out of the mouth*
- *Hairy maxillary palps for sensitivity*
- *Long maxillary palps to reach food at a distance*
- *Segmented palps for flexibility/to push food into the mouth.**rej labial palps hairy***

b) View the anterior part of the head using a hand lens. Draw and label. **(11 marks)**

Drawing of the anterior view of the head of specimen K



C) Cut off the head of the specimen then cut out one eye with as little tissue under it as possible. Place the eye on the slide with the cut side facing downwards. View under the low power of a microscope.

i) Describe the arrangement of the eye units. **(05 marks)**

It consists of hexagonal/polygonal;large;numerous;;closely packed;;ommatidia which are adjacent to each other;;regularly/parallel;;arranged

ii) Draw four adjacent eye units. **Do not** label. **(06marks)**

Drawing of four adjacent eye units of specimen K

x300

P-polygonal
N/U-no of units
A-attachment of units

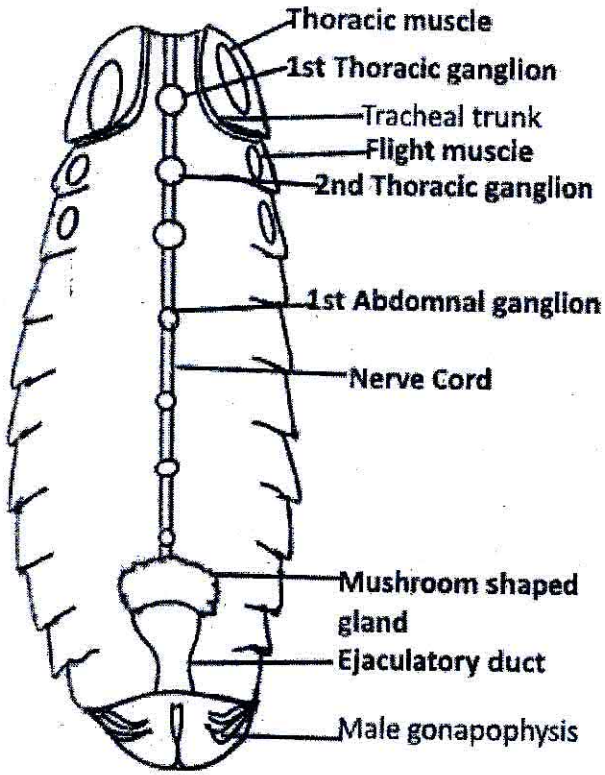
T- 01
O- 01
N- 01
P- 01
A- 01
N/U-01
T=06

iii) What is the significance of the arrangement of the units? **(02marks)**

Numerous ommatidia/units/compact regularly arranged to increase field of view and sensitivity.

c) With the dorsal side uppermost, dissect the specimen to remove the digestive system. Display the structures remaining on the ventral cuticle. Draw and label. **(12marks)**

Drawing of the structres on the ventral cuticle/sternum of specimen K with digestive system removed



T-01
N-01
O-01
M-01
D-04
L-04
D/C-01
T=13

X1-X4

Question 2 **(30marks)**

You are provided with solutions **A(0.25M) ;B(0.2M);C(0.3M);D(0.5M);E(0.15M);F(0.10M)** and **G(0.70M)**which are sucrose solutions of different concentrations and specimen **M(fresh big-sized Irish potato tubers)**

a) Carry out tests on M and the solutions using the procedure provided.

i) Label **14** test tubes in two sets, $A_1,A_2,B_1,B_2,C_1,C_2,D_1,D_2$, E_1,E_2, F_1,F_2 and G_1,G_2.put the solutions into corresponding sets of test tubes in the quantities shown in table 1

TABLE1

TEST TUBE	*SOLUTION ADDED*
A_1,	**3 cm^3 of A**
A_2,	**2 cm^3 of A**
B_1,	**3 cm^3 of B**
B_2,	**2 cm^3 of B**
C_1,,	**3 cm^3 of C**
C_2	**2 cm^3 of C**
D_1,	**3 cm^3 of D**
D_2	**2 cm^3 of D**
E_1	**3 cm^3 of E**
E_2	**2 cm^3 of E**
F_1,	**3 cm^3 of F**
F_2	**2 cm^3 of F**
G_1	**3 cm^3 of G**
G_2	**2 cm^3 of G**

ii) Arrange test **A_1,B_1,C_1,D_1,E_1,F_1 and G_1 in** a front row and **A_2, B_2, C_2 ,D_2 ,E_2, F_2 and G_2** in the back row in a test tube rack.

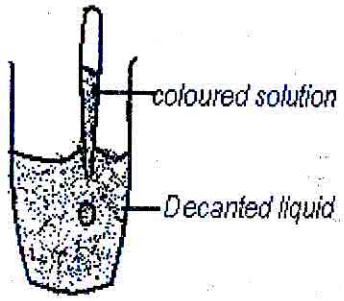
iii) Now add a small drop of methylene blue to each of the test tubes in back row using a dropper just to colour the solutions.

iv) Using a cork borer, prepare seven uniform cylinders from specimen T measuring between 6-8 mm in diameter and 5-6 cm in length.

v) Add one cylinder to each of the test tubes in the front row (uncoloured solutions) and leave for 20 minutes

vi) After 20 minutes, decant the liquid in test tube A1 into another test tube.

vii) using a dropper ,obtain a coloured solution from test tube A2 and add carefully, lower the tip of the dropper into the centre of the decanted liquid, about 5mm from the surface, and release one drop of the coloured solution as shown in fig 1



viii) observe the behavior of the coloured drop and record your observation in table 2.clean the dropper and the test tube and repeat procedures (vi)-(viii) using the liquids in the remaining sets of test tubes by decanting solutions from test tubes with potato cylinder and adding a drop of coloured solution from corresponding test tubes in the back row. (14 marks)

Table 2

Test tube from which liquid is decanted	Behaviour of the coloured drop
A_1,	*Spread horizontally;;*
B_1,	*Rises;; slowly;;*
C_1,,	*Sinks;;slowly;;*
D_1	*Sinks;;moderately;;*
E_1	*Rises;;moderately;;*
F_1,	*Rises;;fast;;*
G_1	*Sinks;;fast;;*

b) Explain the behavior of the coloured drop in each decanted liquid. (**14marks**)

A_1,	*The solution and cell sap of the cylinder are isotonic no net osmotic movement is water; hence concentration and density remain unchanged.*
B_1,	*It is slightly less concentrated than the cell sap of cylinder; it absorbs little WATER from the solution slightly increase in concentration/decrease in volume of the solution and hence slightly increase the density of the solution*
C_1,,	*Solution slightly more concentrated the cell sap of the cylinder; so it absorbs little water becoming slightly dilute with slight decrease in density*
D_1	*Solution moderately more concentrated than the cell sap of the cylinder so absorbs moderate amount of water becoming moderately dilute with moderate decrease in density*
E_1	*Solution moderately less concentrated than the cell sap of the cylinder moderate amount of water absorbed by cylinder solution becomes moderately concentrated leading to moderate increase in density*
F_1,	*The solution is much less concentrated then the cell sap of the cylinder ;solution loses much water to the cylinder and becomes much concentrated ;hence high increase in density;*
G_1	*Solution is much concentrated then the cell sap of the cylinder; much water absorbed by the solution; becoming much dilute; with greatly decreased density*

From your results, estimate the water potential of the cells of **specimen T.** give a reason for your answer. (02marks)

*Water potential of cells of cylinder is equivalent to that of solution **A**; with no net gain or loss of H_2O; causing no chance in density: and concentration.*

Question 3(30.5marks)

(Q = crotalaria; P =hibiscus; R=sweet potato/morning glory; S =guinea grass/panicum maximum; T =maize (part of the inflorescence)

3. Specimens **P; Q; R; S and T** are flowers and inflorescences.

a) Describe the Androecium and gynoecium of each of the specimens **P; Q and R** and of one flower from each specimens **S and T .** **(15marks)**

Table 3

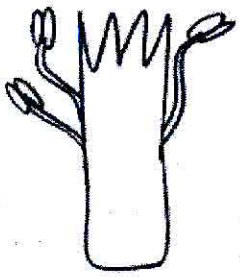
Specimen	Characteristics of androecium	Characteristics of gynoecium
P Hibiscus	*Numerous; filaments fused with a stamen tube; which is long; end of the filament are free and attach anthers which are bilobed; round and brightly coloured;*	***Five** carpel; and fused; broad ;hairy ;sticky stigma leads style long; flexible free superior ovary broad base*
Q Crotalaria	*10 stamens ,nine fused into stamen tube; which are grooved; curved and long with free short filaments, anthers bilobed;round;elongated;brightly coloured*	*One carpel; stigma long/flattened;hairy;short style ;superior long curved smooth ovary*
R Morning glory/sweet potato	*Five stamens,long;free;and slender ;thin filaments ;hairy at the base attached to the petals;filaments taper at the apex;* *bilobed;long;large Anthers*	*2/3 carpels;fused;stigma bilobed/trilobbd;round;hairy style;long;thin;superior ovary round and smooth*
flower of S Guinea grass	*Three stamen; filament long ;thin;* *Anthers pendulous; dull coloured;bilobed large; long loosely attached to filament*	*Two feathery brightly coloured;long stigma; style is short; ovary superior and round;*
flower of T maize	*Three free stamen; free filaments; anthers free; long; slender pendulous smooth large bilobed brightly coloured and loosely attached to filament which are thin, long, flexible and slender.*	**No gynoecium**

b) Using the characteristics of the androecium and gynoecium, construct a dichotomous key to identify the specimens. **(04marks)**

1a) has stamens /filaments/anthers only.....T
1b) has both stamens/female/anthers pistil.....go to 2
2a) filaments are free..... go to 3
2a) filaments are fused/partly fused.....go to 4
3a) has long style .....R
3b) has short style.....S
4a) has one stigma head .....Q
4b) has five stigmatic surface..... P

c) In the space below, draw the androecium of **specimens P and Q.** **(06 marks)**

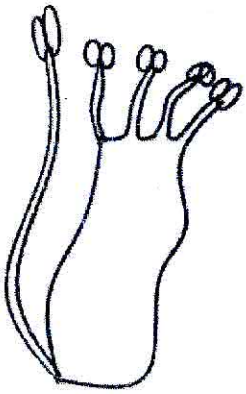
Adroecium of specimen P



N-0.5
O-0.5
M-0.5
D-1.5
A-0.5
T-3.5

X3-X7

Androecium of specimen Q



M-0.5
O-0.5
N-0.5
D-1.5
T-3.5

X2-X10

d) State whether specimen **P** is more likely to be self or cross pollinated.
Explain your answer.

CROSS POLLINATION; *because the stigma heads are above the anther heads;; such that the pollinator/insects from other flowers with pollen reach stigma before anthers;;*

e) Explain how pollination is facilitated by the ***androecium*** of specimen **T**

- *long filament to expose anther heads with pollen grains to wind*
- *large anther heads to produce much pollen grains to enhance pollination;;*
- *filaments are flexible/pendulous for easy swinging to release the pollen easily;;*
- *anthers are loosely attached to the filament to easily scatter the pollen;;*

UACE BIOLGY PAPER 3 2012

Question 1

You are provided with specimen K which is freshly killed.

(a) (i) Identify the sex of the specimen. (01mark)

Male/female

b) Describe the structures you used to determine the sex of the specimen. (02marks)

MALE

PENIS elongated/long, covered by a loose sheath/prepuce which is cylindrical, solid with scanty hair, slit-like aperture at the tip.

Scrotal sacs/scrotum, swollen, sac like, elongated, with short scanty hair and two swellings with a depression in the middle

FEMALE

Clitoris, a small projection/protrusion, solid, cylindrical, with a small opening at the tip and short scanty hair.

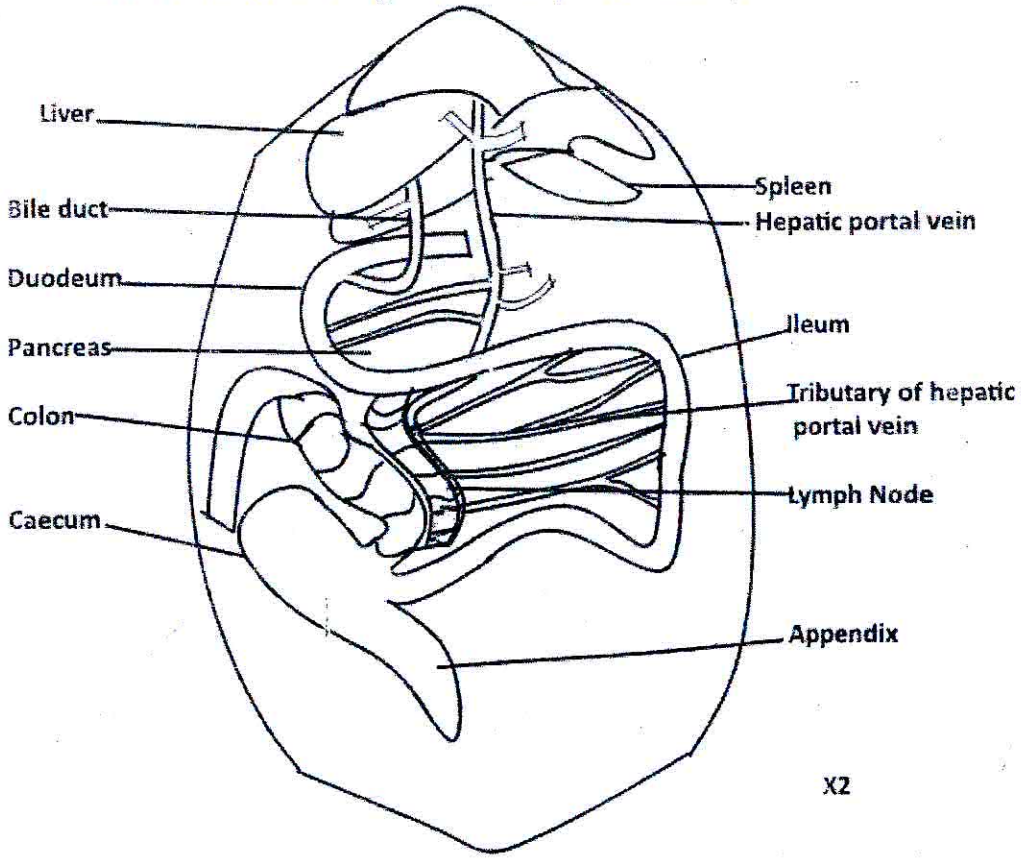
Nipple, small projection, short, cylindrical, smooth and solid.

Vulva/vaginal opening; oval/circular/round opening

(b) Dissect the specimen to display the contents of the abdominal cavity. Cut out the stomach without breaking much of the mesentery. Displace the duodenum loop to the right of the specimen, then turn the bulk of the ileum to the left of the specimen. Displace the colon and the caecum downwards to the right of the specimen to display the vessels that carry blood from the alimentary canal to the liver which is displaced anteriorly.

Draw and label structures visible in the abdominal region in the space provided on the next page. *(23 marks)*

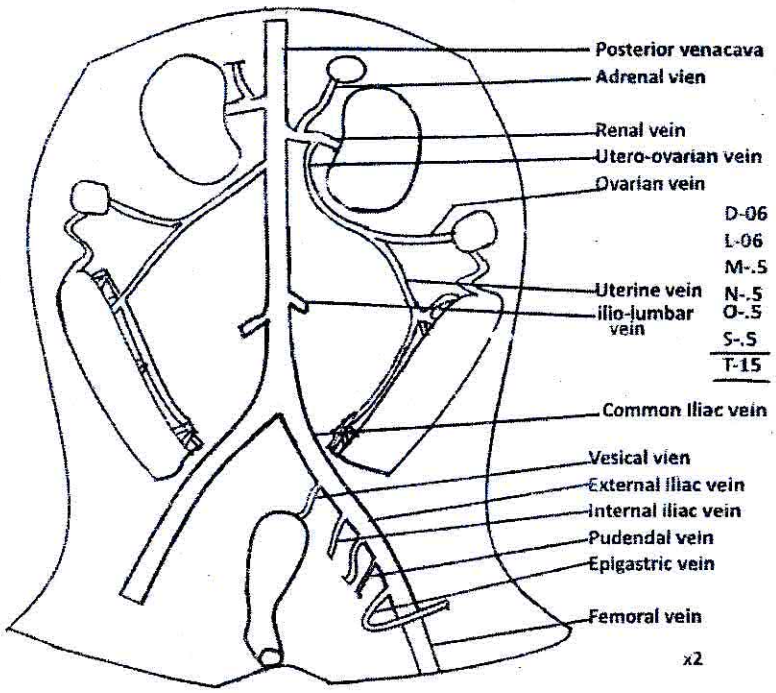
Drawing showing the structures in the abdominal region of specimen K without the stomach with duodenum displaced to the right, ileum to left ,colon and caecum down wards and to the right and liver displaced anteriorly.



(c) Cut out the alimentary canal then continue to dissect to display the vessels that drain blood from the upper parts of the hind limbs and abdominal region, back to the heart.

Draw and label the vessels on the left hand side of the specimen excluding the heart. ***(13marks)***

Drawing of blood vessels that drain blood from the upper parts of the hind limbs and abdominal region back to the heart of the left hand side of the specimen K



Question 2

You are provided with solutions **W(2%yeast solution), X(1% starch), Y(1% sucrose solution) and Z(1 % glucose)**. Solutions X, Y and Z contain food nutrients. You are required to carry out tests to determine the food nutrients contained in the solutions and investigate the action of solution W on solutions X, Y and Z following the instructions provided.

a) Carry out the iodine and Benedict's tests on solutions X, Y and Z and record your tests, observations and deductions in Table 1. **(15marks)**

Table 1

Test	Solution	Observations	Deductions
(i) Iodine test To 1 cm^3; of solution add 1/2/3 drops; of iodine solution;	**X**	*Milky/cloudy/Turbid/colourless solution turns to blue-black solution*	*Much; starch present;*
	Y	*Colourless solution; turns to pale/faint/light brown or pale yellow/yellow solution;*	*Starch absent;*
	Z	*Colourless solution; turns to pale/faint/light brown or pale yellow/yellow solution;*	*Starch absent;*
Test	**Solution**	**Observations**	**Deductions**
(ii) Benedict's test To 1 cm^3; of solution add	**X**	*Milky/cloudy/Turbid/colourless solution turns to pale blue solution;*	*Reducing sugars absent;*

$1cm^3$ Benedict's solution;and boil ;	Y	*Colourless solution; turns to pale blue solution;*	*Reducing sugars absent;*
	Z	*Colourless solution; turns to pale blue solution; to green solution; to yellow ppt;orange ppt;*	*Much; reducing sugars;*

b) Label 3 test tubes **as X, Y and Z** and add into each of them 2 cm^3 of the corresponding solution followed by 2 cm^3 of solution W.Incubate the mixtures at a temperature of **37°C-40°C** for 1 hour. (You may proceed with other work in the meantime). After 1 hour, carry out the iodine and Benedicts' tests and record your observations and deductions in the following Table 2. **(12 marks)**

Table 2

Test	*Solutions*	*Observations*	*Deductions*
Iodine test	***X + W***	*Milky/Turbid solution turns to **pale black/** pale blue-black/purple solution/black*	*Little ; starch present;*
	Y + W	*Milky//Turbid solution turns to **pale** brown solution /pale yellow/yellow solution;*	*starch absent;*
	Z + W	*Milky//Turbid solution turns to **pale** brown solution /pale yellow/yellow solution;*	*starch absent;*
Benedict's test	***X + W***	*Milky//Turbid solution turns to **pale** blue solution to green solution/yellow ppt*	*Little/moderate reducing sugars;*
	Y + W	*Milky//Turbid solution turns to **pale** blue solution to green solution then to yellow ppt/orange ppt;*	*Moderate/much; reducing sugars;*
	Z + W	*Milky//Turbid solution turns to **pale** blue solution to greenish yellow ppt/ yellowish green ppt/yellow ppt;*	*little/Moderate; reducing sugars;*

(c) Suggest

i) Explanations for your results in (b) **(07 marks)**

- *The amount /concentration of starch in solution X reduced; because W contains an enzyme/active substance; that catalysed the hydrolysis/breakdown of starch; to reducing sugars.*
- *Solution Y was hydrolysed/broken down to reducing sugars; by enzyme/active substance in **W**.*
- *The concentration of reducing sugars in Z reduced due to breakdown /decomposition; by active substance in **W***

(ii) The nature of **W.** **(03 marks)**

- ***W** contains enzymes that catalyzes the breakdown of **starch;** solution **Y;** and reducing sugars; in Z at a temperature of 35^oC- 40^oC*

QUESTION 3

You are provided with specimens **S (open commelina)** and **T (shade commelina)** and solutions **A (water), B (0.3M) and C(0.7M).**

Specimens S and T are from plants of the same species but grown under different habitats. Solutions A, B and C are sucrose solutions of different concentrations.

(a)Examine specimens **S and T** using a hand lens where necessary and state **one** difference between the specimens.

(01 mark)

S -open sun /lit	T- Shade/shady/dim light
• *Pale Green/less green -less chlorophyll - exposed to much sun light.*	• *Dark green/deep green-much chlorophyll for max light absorption*
• *Narrow lamina /smaller surface area*	• *Broad lamina/large surface area*
• *More hairy* • *Thin leaf surface*	• *less hairy* • *Thick lamina*

(b) Label four microscope slides at their edges as S-upper epidermis, S-lower epidermis, T-upper epidermis and T-lower epidermis. From each specimen peel a small piece of the upper epidermis and lower epidermis one at a time and mount in a drop of water on the corresponding microscope slide. Cover the mountings with cover slips and view them one at a time, under the low power of a microscope. For each piece of epidermis viewed, count the number of stomata visible in the field of view and record your results in TOable 3.

(04mks)

specimen	No. of stomata upper epidermis	No. of stomata lower epidermis
S	**20-70**	**80-500**
T	**40-15**	**60-350**

(c)From your results in (a) and (b) suggest the type of habitat from which each specimen was obtained giving two reasons.

(02 marks)

S—SUNNY/open terrestrial habitat

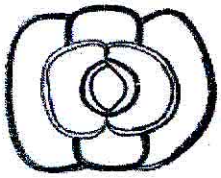
- Fewer no of stomata to reduce water loss
- Much hair to reduce rate of water loss
- Narrow leaf surface/lamina reduces Surface area to minimize water loss.
- Much more stomata on lower and fewer on upper epidermis to reduce water loss
- More number of stomata than T to increase water loss hence rapid cooling.

T—shady/damp terrestrial habitat/dimly lit

- More number of stomata on the lower than upper to minimize water loss.
- Deep green ,much chlorophyll to maximize light absorption
- Broad lamina to increase surface area exposed to sunlight/for max light absorption.
- Less hairy because need to conserve water /to enhance transpiration.

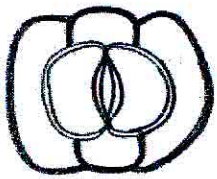
(d) Label three microscope slides at their edges as **A, B and C** and on each slide, add a drop of the corresponding solution. Peel three small pieces of the lower epidermis from **specimen S** and mount a piece with the outer-side uppermost, in each solution on the slides. Leave the set up for 20 minutes. After 20 minutes cover each mounted piece with a cover slip and observe under the low power of a microscope. Draw one stoma with its adjacent cells from each slide, in the space provided. ***(09mks)***

From slide A



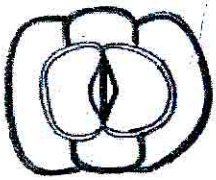
Wide aperture

From slide B



Narrow aperture

From slide C



Closed aperture

e) Explain what is observed from each slide **(09marks)**

i) ***From slide A***

solution A had lowest concentration/high water potential/low osmotic pressure/high solute potential/very dilute/hypotonic solution; compared to the cell sap; which caused the guard cell to take up water/absorb water by osmosis; resulting into the high turgidity/cells becoming turgid hence stoma opens widely;

ii) ***From slide B***

solution B was slightly/less concentrated/same concentration with the cell sap; which caused the guard cell to slightly take up water/absorb water by osmosis; resulting into less/slight turgidity hence stoma slightly opens;

Or *solution B slight concentration/slight plasmolysis/same concentration, no net movement of water by osmosis resulting into less turgidity /no slight change in stomata opening*

iii) ***From slide C***

solution C had the highest concentration/lowest water potential/high osmotic pressure/low solute potential/hypertonic solution; compared to the cell sap; which caused the guard cell to loss water by osmosis; resulting into cells becoming plasmolysed /flaccid hence stoma closes;

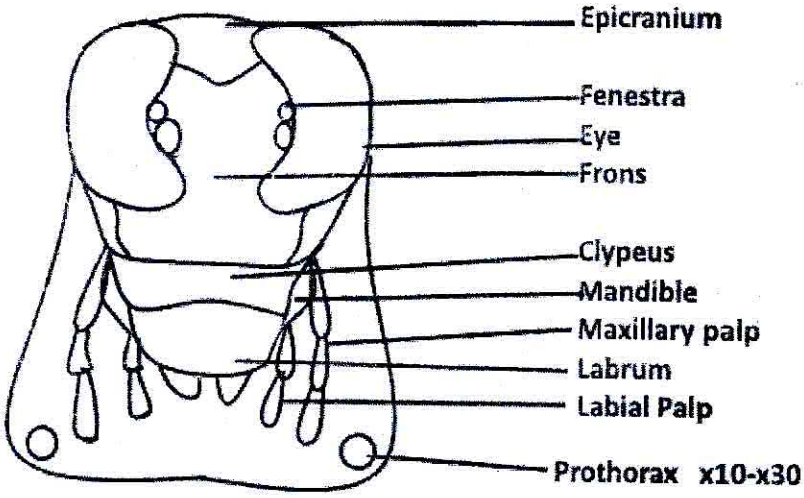
UACE BIOLGY PAPER 3 2011

Question 1

You are provided with specimen **T (cockroach)** which is freshly killed

(a) Place the specimen ventral side upper most and cut off its antennae and limbs. Observe the head and the first thoracic segment. Draw and label.

Drawing showing the head and the first thoracic segment when the specimen is ventral side upper most with the antennae and limbs cut off of specimen T



b) Turn the specimen dorsal side upper most and examine the the wings when pulled outwards. describe their structure.

(i) Outer wings ***Thick; straight; elongated/long/oblong; narrow; veined***

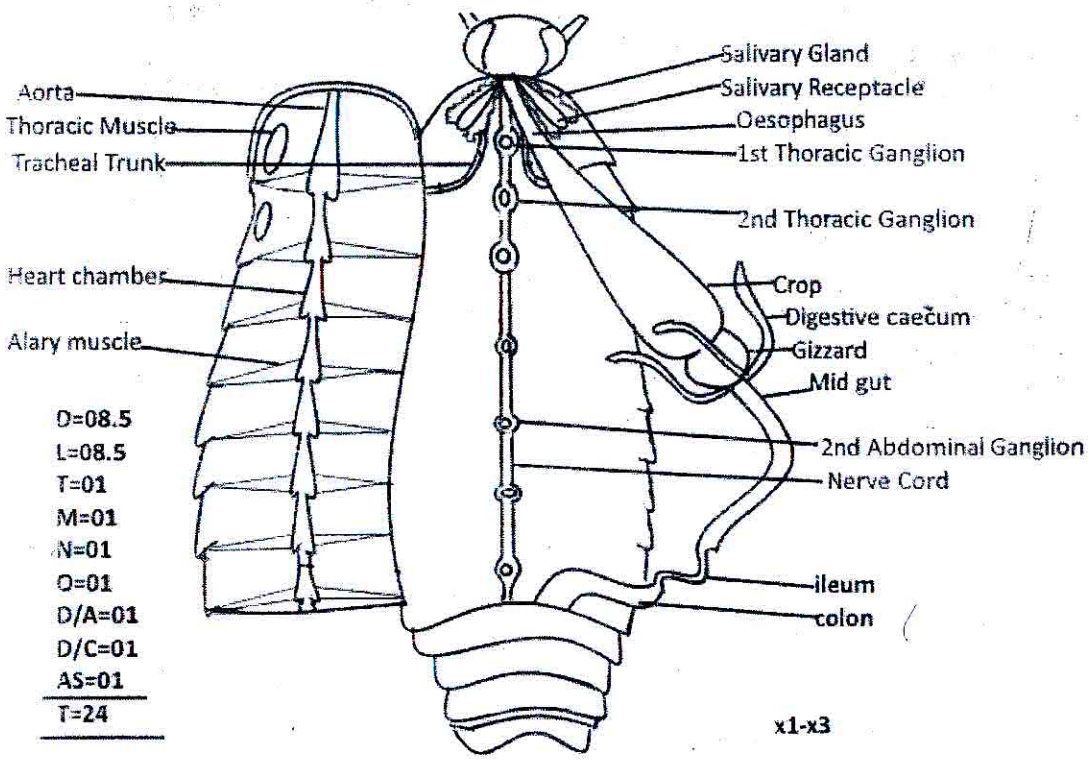
(ii) Inner wings ***Membranous/thin; broad; notched margin; folded and network of veins.***

b) Cut off wings. Cut along the right lateral line of the body from the anterior part of the thorax up to the 8th segment. Turn the dorsal cuticle to the left and clear any fat tissues. Carefully displace only exposed structures on the ventral cuticle. draw and label your dissection showing:

(i) All internal structures on both cuticles.

(ii) Parts of the digestive system used for storage, digestion and absorption. **(24 marks)**

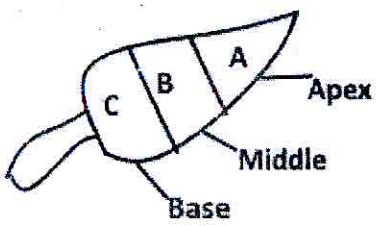
A drawing Specimen T showing internal structures after opening thoracic region and the five abdominal segments with alimentary canal displaced to right side of the specimen.



Question 2

You are provided with specimen **M, N_1 and N_2** which are plant parts.

a) Peel specimen **M** and cut it into three parts namely, apex, middle and base as shown in figure 1.



Put the apex in a mortal and grind using a pestle. Decant at least 4 cm^3 of the juice into a test tube, add an equal amount of water and label the extract **A.**

Clean the mortar and pestle and repeat the procedure using middle part of **M,** to obtain an extract and label it **C.**

Clean the mortar and pestle and repeat the procedure using the base part of **M,** to obtain an extract and label it **C.**

Carry out a DCPIP test, Benedict's test and biuret test on each extract .record your tests observations and deductions in table.

For DCPIP test, record the number of drops required to decolourise DCPIP.

Tests	Observation/number of drops	Deductions
DCPIP test *To 1/2cm;^{3} of DCPIP solution ;was added solution* ***A/B/C*** *drop wise till excess;*	***A*** ***4-6***	***Much vitamin C present;***
	B ***6-7***	***Moderate vitamin C present;***
	C ***7-8 ,17,18***	***Little vitamin C present;***
Biuret test *To 1/2cm$^{3;}$ of Solution* ***A/B/C*** *was added 1/2cm$^{3;}$ of NaOH solution; followed by 3/4 drops; of $CuSO_4$solution;*	***A*** *Turbid/colourless/yellow solution turned to blue; then to pale purple solution;*	*Little proteins present;*
	B *Turbid/colourless/yellow solution turned to blue solution/pale purple;*	*No/Little proteins present;*
	C *Turbid/colourless/yellow solution turned to blue solution/pale purple;*	*No/little proteins present;*
Benedict's test *To 1/2cm^3 ;of solution A/B/C was added1cm^3 ;of Benedict's Solution ;and boil for 2 min*	A *Turbid/colourless/yellow solution turned to blue solution; to green solution; then to yellow ppt;*	Moderate reducing sugars present;
	B *Turbid/colourless/yellow solution turned to blue solution; to green solution; then to yellow ppt; orange ppt;*	Much reducing sugars present;
	C *Turbid/colourless/yellow solution turned to blue solution; to green solution; then to yellow ppt; orange ppt; brown ppt;*	Very much reducing sugars present;

a) Describe the pattern of distribution of food substances in specimen **M.** **(03 marks)**

- *The amount of vitamin C increases from base too apex/decreases from apex to the base;*
- *The amount of reducing sugars decreases from base to the apex/it increases from apex to the base;*
- *The amount of proteins decreases from apex to the base/accept remains the same*

c) Specimen **N_1(raw banana) and N_2(ripe banana)** are parts of a fruits at different stages of development. Peel and cut from each specimen, a piece measuring 3cm x3cm x 3cm . Using a mortar and pestle, grind the piece from N1 into a paste, add 10 cm3of water , stir well and leave to settle . After settling, decant off the solution and label it **E.** Repeat the procedure using the piece from specimen N_2,

and label it **F.** Carry out an iodine test, a Benedict's test and Biuret test on each solution. Record your observations and deductions **Table 2.**

Tests		Obervations	Deductions
Iodine test *To 1/2cm;^{3} of solution E, F; was added 2 drops of iodine solution;*	E	*Turbid/colourless solution/suspension turns to black/blue-black solution;*	*Much starch present;*
	F	*Turns to pale blue/purple/specks of black particles*	*Traces of starch present;*
Benedict's test	E	*Turbid/colourless solution turns pale blue then to green solution /yellow ppt;*	*Moderate reducing sugars present;*
	F	*Turbid solution turns to pale blue solution which on boiling urns to green solution then to yellow ppt finally to Orange/brown ppt;*	*Much reducing present;*
Biuret test	E	*Faint/pale purple solution*	*Traces/little protein present;*
	F	*Faint/pale purple solution*	*Traces/little protein present;*

d) (i) describe the relationship between the distribution of food substances and development of the fruit from which **N_1 and N_2** were obtained.(2.5 marks)

As the fruit ripens; the amount of starch reduces; amount of reducing sugars increases; and the amount of proteins remain the same

iii) From your results in Table 2, comment on the suitability of specimens $N_1$and N^2 as the main diet for a young child.

N_1 and N_2 *not suitable for main diet for a young child because there is little proteins needed for the growth of the child;*

QUESTION 3

You are provided with specimen **K (onion bulb)**
a) Cut it longitudinally and examine it. Describe its internal structure **(3mks)**

A stem at the base; short flattened/disc shaped; on which are attached; thick/fleshy/succulent closely packed; leaves curved outward; tapering each at the apex; and base; with buds arising from axils in between fleshy leaves/surrounded by fleshy leaves;

b) Remove one of the leaves of **specimen K.**Strip off a piece of the inner most layer and place it on a slide with a drop of water and cover with a cover slip. Examine under the medium power of microscope.

i) Describe the structure of a cell, clearly seen (2mks)

It is polygonal/hexagonal/rectangular/four/six sided; long/elongated; thick cell wall; round /circular/spherical nucleus;

ii) Now examine under lower power of a microscope, account and record the number of cells in field of view. **(2mks)**

From left to right
2 – 15;
From top to bottom
14 - 45,

c) (i) remove the slide from stage ,measure the field of view using a transparent ruler and record your results. **(1mk)**

Field of view ***1.0 - 2.0 mm***

i) Convert the diameter of the field into micrometers (**µm**).show your **working** (2mks)

1 mm===1000 µm;
*Diameter of flied of view =**2.0mm***

1mm ⟶ *1000 µ m;*
2mm ⟶ *2 x 1000;*

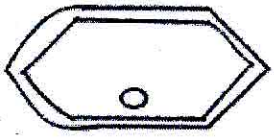
Therefore Field of view= ***2000 µ m;***

iii) Calculate the actual length of the one cell in micrometers (um).show your working. **(03mks)**

Actual length of the cell = ***field of view***
Total number of cells lying across
If the Number of cells = ***4;***
*Field of view =**2000 µ m;***
Actual size of the cell= ***2000 / 4 = 500µ m;***

d) Return the slide having the tissue onto the stage, draw one cell from the tissue being observed under the medium power of a micrometer. **(03mks)**

Drawing of one cell from the tissue of specimen K being observed under medium power of a microscope;



P/Polygonal=0.5
C/Clear inside=0.5
T/Thickness=0.5
L/Length=0.5
T=02

e) Measure the length of your drawing in mm and record it. **(1mk)**

Length of drawing= ***80 mm***

ii) Calculate the magnification of your drawing, show your working. **(3mks)**

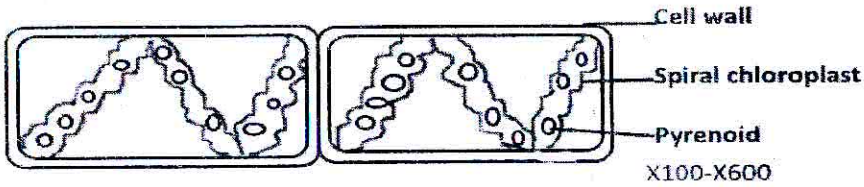
1mm ⟶ *1000 µ m;*

80 mm ⟶ *80 x 1000;*

$$Mg = \frac{\text{length of the drawing}}{\text{Actual length of one cell}} = \frac{80000\ \mu m}{500} = \mathbf{x160}$$

f) Mount a little piece of **specimen L(spirogyra)** and view under the medium power of microscope. Draw and label one cell. **(5mks)**

A drawing of one cell of specimen L under medium power of a microscope.



X100-X600

g) Explain how the structure of each of the cells from specimen K and L relate to their functions. **(4mks)**

i) **Cell from K**

- *Thick cell wall for protection;*
- *Elongated/long to increase surface area for protection*

ii) **Cell from L**

- *circular pyrenoids to store much food;*
- *thick cell wall for protection;*
- *spiral chloroplast to increase surface area absorbing/ trapping sun light energy for photosynthesis;*

UACE BIOLOGY PAPER 3 2010

Question 1

You are provided with specimen **p(rat)** which is freshly killed.

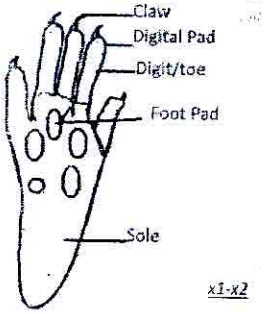
(a) Examine the ventral side of the right fore and right hind feet.

(i) State two observable differences between the fore foot and hind foot. (02marks)

Fore foot	Hind foot
1.Has four well developed digits	*Has five well developed digits*
2.Is relatively short/has relatively short digits	*Is relatively long/has relatively long digits*
3.The first digit is reduced	*The first digit is fully developed*
4.Less muscular	*More muscular/much thicker*

(I) Draw and label the ventral side of a hind foot. (6marks)

A drawing of the ventral side of right hind foot of specimen P



D-02
M-0.5
T-0.5
N-0.5
L-02
O-0.5
T-06

x1-x2

(iii) State the importance of the features labeled on the foot. (5 marks

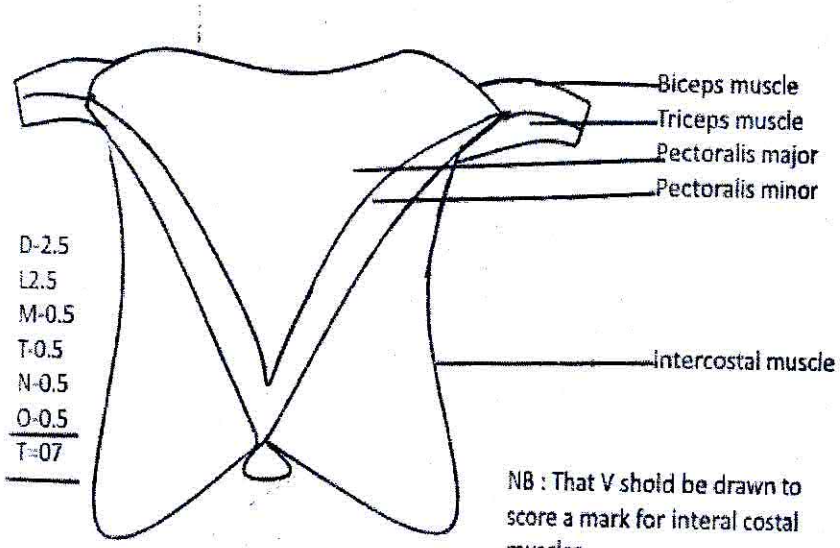
Claw/nail; for defense against its enemies; digging burrows in the ground /burrowing; firm grip during locomotion;
Pads; for minimizing /reducing noise during locomotion; allow firm grip during locomotion;
Long Digits/toes; for firm grip during locomotion.

(b)Place the animal ventral side upper most, examine it and identify its sex, giving a reason. (2 marks)

Sex: Male /Female;
Reason:
*Male – **it possesses scrotal sacs; /prepuce covering the penis;***
*Female – **it possesses the genital/vaginal opening; vulva/clitoris; teats/nipples;***

c) Dissect the specimen to expose the muscles of the thorax and fore limbs up to the elbows. Draw and label.

A Drawing of muscles of the thorax and forelimbs up to the elbows of specimen P



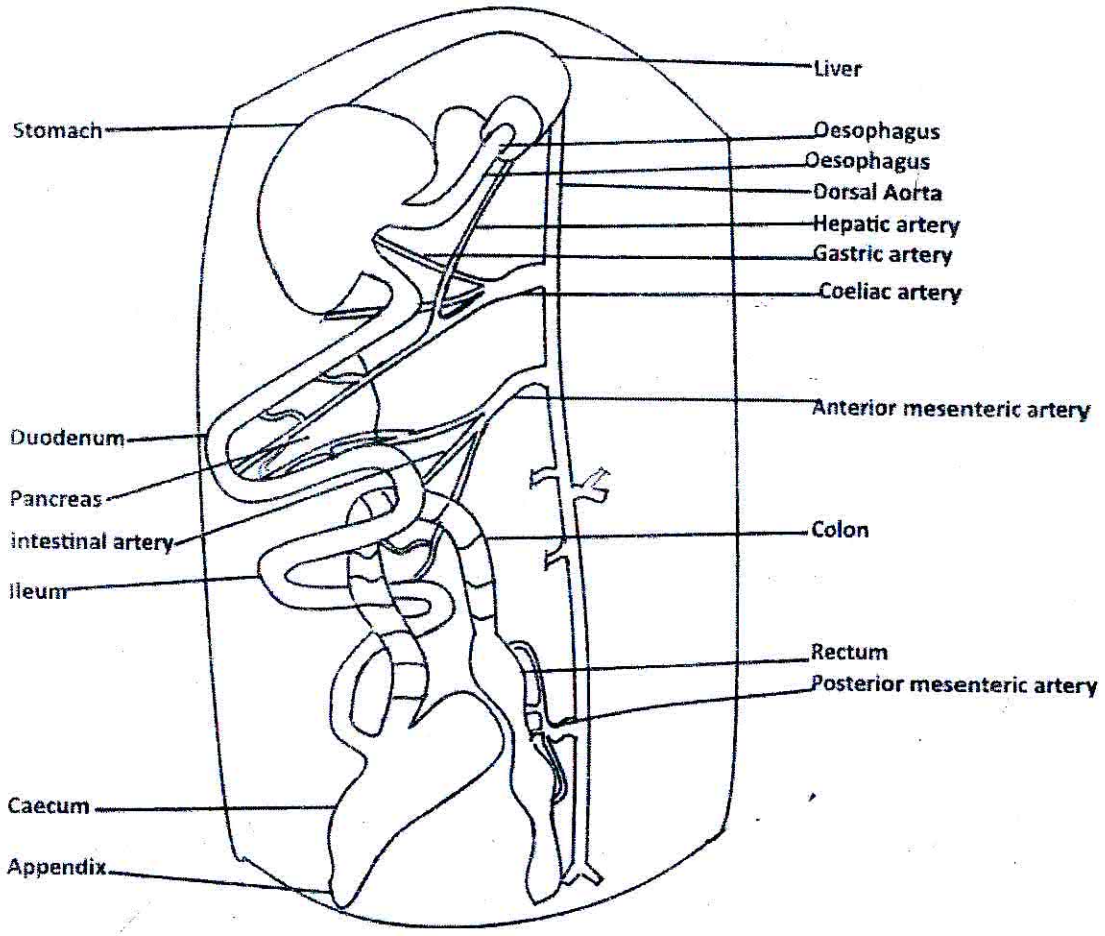
D-2.5
L2.5
M-0.5
T-0.5
N-0.5
O-0.5
T=07

NB : That V shold be drawn to score a mark for interal costal muscles

x0.5-x2

(d) By further dissection, display the blood vessels supplying the digestive system. Deflect the alimentary canal to the right of the specimen, draw and label. **(20 marks)**

Drawing showing blood vessels supplying digestive system with alimentary displaced to the right of specimen P



Question 2

Solution **X**=extract from 120g of Irish potato in a litre; **solution Y**= extract from 300g of Irish potato in a litre; **solution Z**= extract from 600g of Irish potato in a litre; **solution Q=10 vol hydrogen peroxide**

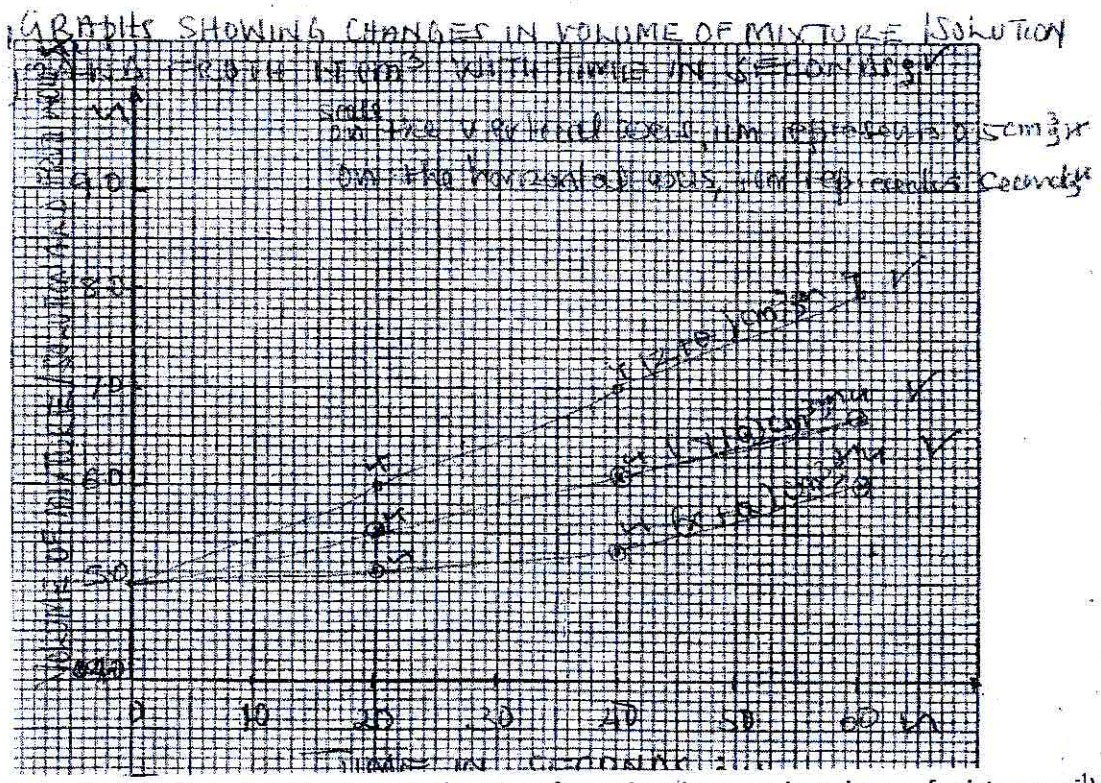
You are provided with solutions **X, Y and Z** which are extracts of a plant tissue, at different concentrations and solution **Q.** You are to carry out tests using the solutions and answer the questions that follow.

(a) In a 10 ml measuring cylinder, add 3 cm^3 of solution **X** followed by 2 cm^3 of solution **Q** and at the same time start a stop clock. Observe the reaction and record the volume of the contents including the bubbles/froth, every 20 seconds for 60 seconds, in table 1. Repeat the procedure with solutions **Y and Z** and record the results in the table. **(6marks)**

Table 1

Time (s)	Volume of mixture of (X+Q) (cm^3)	Volume of mixture of (Y+Q) (cm^3)	Volume of mixture of (Z+Q)(cm^3
0	*5.0*	*5.0*	*5.0*
20	*5.1*	*5.5*	*6.0*
40	*5.3*	*6.1*	*7.0*
60	*6.0*	*6.7*	*8.0*

b).(i) Using same axes, represent your results in a graphical forming the space provided below.



(ii)Using the graphs in (b) (i), calculate the rate of reaction (increase in volume of mixtures s^{-1}) for each mixture. Show your working. (3 marks)

X+Q

Change in volume/Final – Initial volume

Time

$\frac{6.0-5.0}{60}$ = **$0.017cm^3/sec$**

Y+Q

$\frac{6.7-5.0}{60}$ = **$0.03\ cm^3/sec$**

Z+Q

$\frac{8.0-5.0}{60}$ = **$0.05\ cm^3/sec$**

(c) (i) state what is being investigated in the tests. **(1 mark)**
The effect of enzyme/catalase concentration on the rate of reaction/decomposition of Q / H_2O_2.

(ii) Explain the results of your tests. **(3mark)**

*Solution **Z** had the highest number of enzyme molecules/active sites; which increased chances of collision with substrate molecules; hence higher rate of reaction;*
*Solution **Y** had moderate/few number of enzyme molecules/active sites; with moderate chances of collision with substrate molecules; hence moderate rate of reaction;*
*Solution **X** had least /fewer number of enzyme molecules/active sites; with least chances of collision with substrate molecules; hence least rate of reaction;*

Question 3
You are provided with specimens **K (bougainvillea) and M (Gynandopisis gynandra)** which are inflorescences.
(a)Describe the flower arrangement on specimen **M.** (1mark)

Individual un stalked flowers; attached along elongated main axis/peduncle; arranged spirally/alternately; with older flowers lowermost; and younger flowers uppermost; ending at the same level;

(b) Pick one flower from each inflorescence and examine it using a hand lens. Describe the structure of each flower with respect to the specified parts as indicated in Table 2 **(15marks)**

Part of flower	Flower from specimen K	Flower from specimen M
CALYX	*Fused with corolla to form a perianth*	*Free; hairy; taper towards the tip/boat shaped /curved inwards;*
COROLLA	*Fused petals , fused with sepals to form a tubular perianth;*	*Free; smooth; veined; narrow at base, and broad at the tip;*
BRACTS	*Large /broad; veined; thin; smooth;*	*No bracts;*
STAMENS	*Long; slender; free; smooth; filaments and bilobed ;circular anthers;*	*Free; long ; slender filaments with bilobed ; elongated anthers;*
PISTIL	*Elongated; Superior; ovary with short; style and elongated ;hairy stigma;*	*Slender; elongated; superior ovary; with short /reduced; hairy style; and bilobed; hairy; spherical; stigma;*

(c) What peculiar features of specimen **M** are not found in a typical flower? **(3marks)**

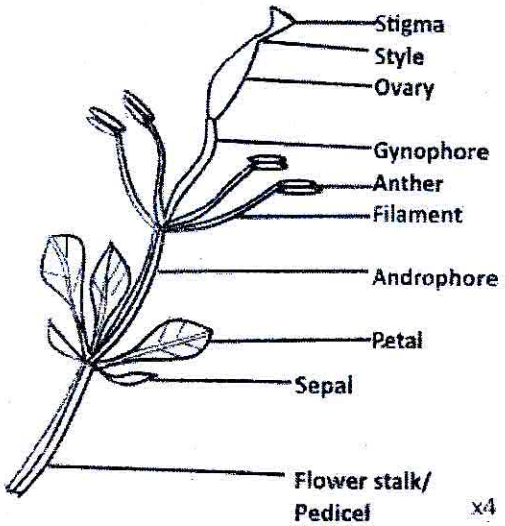
Stamen with stalk/ androphore; Ovary with stalk/ gynophores; distinct nodes and internodes/androphore continue with gynophores/gynophore attached to gynophores;

(d) What ecological significance of the features in (c) to the plant from which Specimen **M** was obtained? **(1 mark)**

Arrangement of features exposes the essential parts of the flower for easy pollination;

(e) Draw and label the external features of a flower from specimen **M.** **(13marks)**

Drawing of the external features of specimen M



UACE BIOLGY PAPER 3 2009

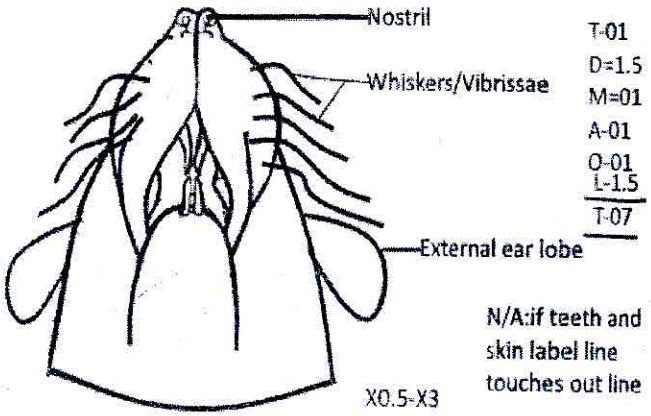
Question 1

You are provided with fleshly killed **labeled K (rat).**

a) Observe the ventral view of the head.

i) Draw and label the ventral side of the head to show the structures for sensitivity. (7mks)

Drawing of the ventral side of the head showing structures for sensitivity of specimen K

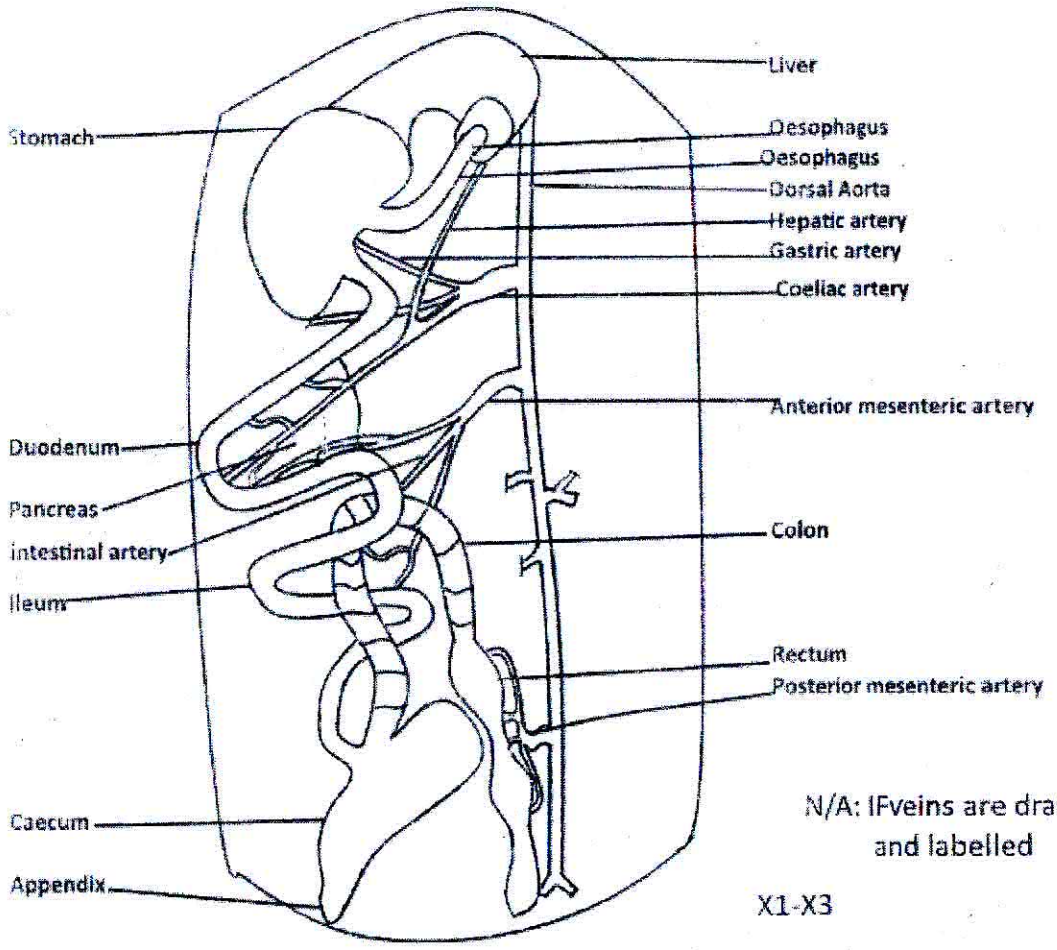


ii) How are the structures labeled in (a) (i) adapted for their functions? (6mks)

- *Nostril is an open air passage;(with scanty/hair) for breathing; to ease air passage/allow in chemicals from the air/smell*
- *Vibrissae/whiskers are long/stiff hairs; which easily get in contact with objects in their way stimulating sense of touch/changes of pressure/determines the diameter of the burrows*
- *External ears have a large Surface area/large pinna/funnel shape for trapping/collection of sound waves*

b) Dissect the specimen to expose the alimentary canal. Deflect the alimentary canal to the right side of the animal to display the blood vessels supplying the alimentary canal and its associated organs. Draw and label. **(21mks)**

Drawing showing the arteries/blood vessels supplying the alimentary canal and its associated organs with the alimentary canal displaced to the right of specimen K



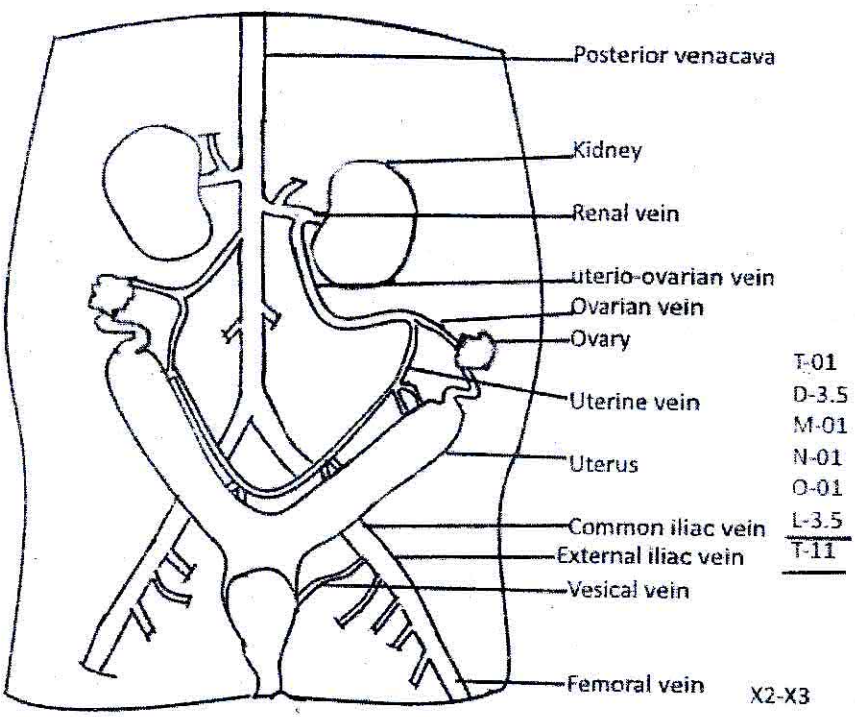
N/A: IFveins are drawn and labelled

X1-X3

c) Remove the alimentary canal, dissect the pelvic girdle and display the major blood vessels that drain the hind limbs and urinogenital system.

Draw and label **(10mks)**

DRAWING SHOWING THE BLOOD VESSELS THAT DRAIN BLOOD FROM THE HIND LIMBS AND URINOGENITAL SYSTEM OF SPECIMEN K



T-01
D-3.5
M-01
N-01
O-01
L-3.5
T-11

X2-X3

Question 2 **(45 minutes)**

You are provided with specimen **S(*about to ripe orange*)**.You are required to carry out tests on the specimen using the procedure provided ,then answer the questions that follow.

Procedure

- Label five test tubes as A, B, C, D and E.
- Peel specimen S, choose five large locular segments and separate them individually.
- Squeeze the juice from segment into a test tube labeled A
- Place the remaining four segments in a beaker and when it starts boiling, start a stop clock.
- Remove the segments from the boiling water one at a time ,after a minute ,4minutes ,6 minutes and 10 minutes ,and place them in a petri dish .(take care to note which segment has been boiled for how long)
- After the segments have cooled, squeeze, the juice from each of them into labeled test tubes as indicated in a table below.

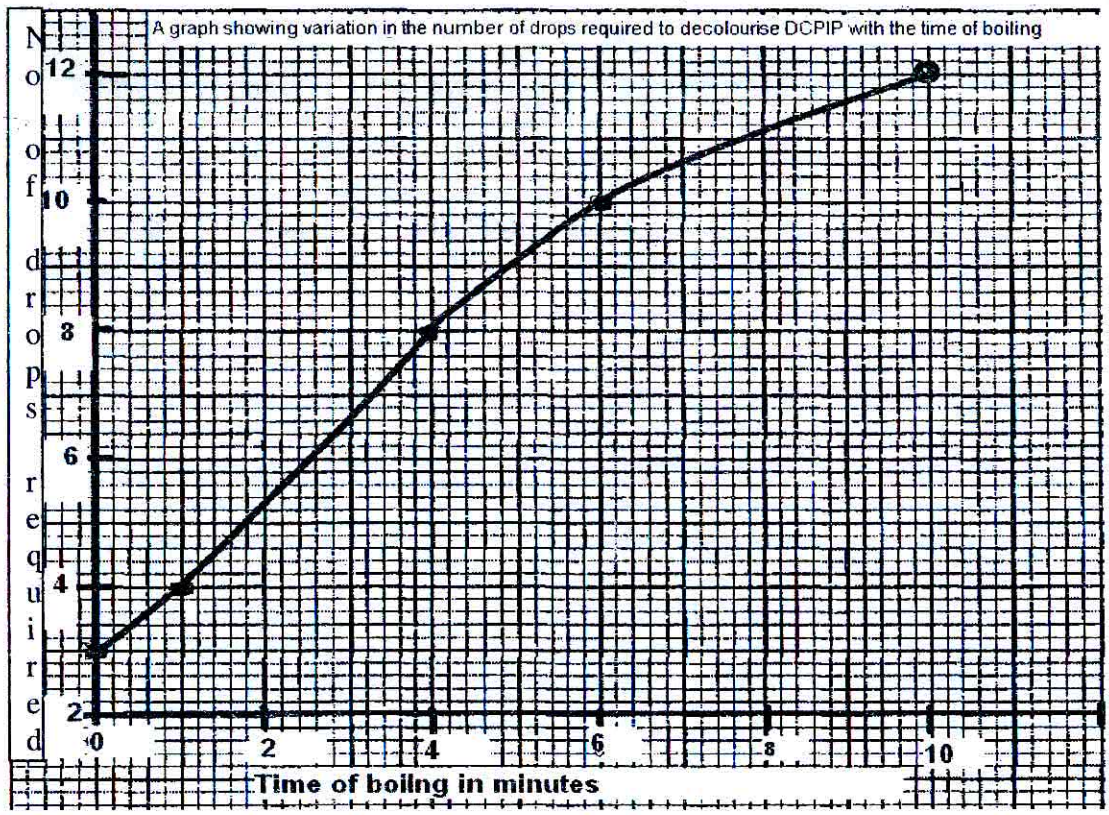
Duration the segment has been boiled(minutes)	Test tube into which juice is squeezed
1	B
4	C
6	D
10	E

A) Carryout the following tests using the juices prepared.

To $2cm^3$ of DCPIP solution in the test tube add the juice from test tube A, drop by drop using a dropper ,and record the number of drops required to decolourise the DCPIP solution, a table below. (5mks)

Test tube containing juice	Duration the segment Was boiled (minutes)	Number of drops of juice needed to decolourise DCPIP)
A	0	***03-10***
B	1	***04-15***
C	4	***08-26***
D	6	***10-30***
E	10	***12-35***

b).represent your result on a graph, in the space below. **(11marks)**



C) (i)State the conclusion drawn from these results (1mk)

*With increasing time of boiling; the vitamin **C** concentration decreases*

ii) State two explanations for your results (5mks)

Boiling destroys/breaks down/oxidizes vitamin C .the longer; the boiling the more the vitamin C ;is destroyed/broken down;

Boiling makes the locule wall more permeable; which makes vitamin C to diffuse out of the locule; and water to enter inside/dilute the vitamin C;

iii) Suggest how one of the suggestions in (c) (ii) can be verified **(2mks)**

Test the water in which the segments were boiled for the presence of vitamin c; test the vitamin C concentration in the locule juice;

d) What is the significance of your results from the tests **(1mk)**

- *Fruits with vitamin C should be eaten fresh/unboiled/raw to provide a high content of vitamin C.*
- *Fruits should not be stored in cold/cool places/fresh fruits/vegetative with vitamin C should not be boiled for long time as this reduces vitamin C content*

Question 3

You are provided with specimen **X (panicum maximum inflorescence)** and **Y (hibiscus)** which are reproductive parts of flowering plants.

a) Remove a spikelet from specimen X and examine it using a hand lens

i) Describe the structures of the spikelet **(4mks)**

Spikelet is stalked/pediculate; which is thin/slender; hermaphrodite/bisexual; bilobed anthers; long; thin/slender filament; forked; two; feathery stigma; smooth; parallel veined bracts; boat shaped/curved tapering towards the tip;
Zygomorphic florets; two florets; one unisexual/staminate; and the other bisexual/hermaphrodite; superior ovary;

ii) Describe the features of **X that** promote the propagation of the plant from which it was obtained. **(4mks)**

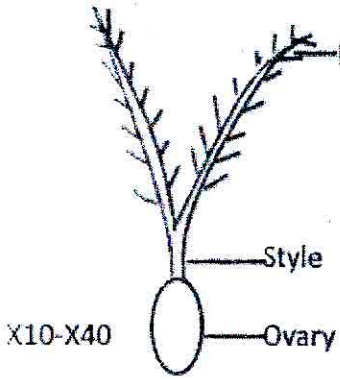
Feathery stigma; to offer large surface area to increase chances of pollination
Loosely attached anthers to filament/pendulous stamen so that the pollen grains are easily blown out by wind;
Bisexual/hermaphrodite; to increase chances of pollination elongated/large anther heads; for producing large quantities of pollen grains;

b) Examine specimen **Y** and state three structural features which are unique to specimen **Y** and not found on **X.** **(3mks)**

- *Epicalyx*
- *Sepals/calyx*
- *Large petal/corolla*
- *Staminal tube/fused filament.*

c)(i) Open up the spikelet of specimen **X** and expose the gynoecium.
Draw and label. **(4mks)**

Drawing showing Gynoecium of specimen X

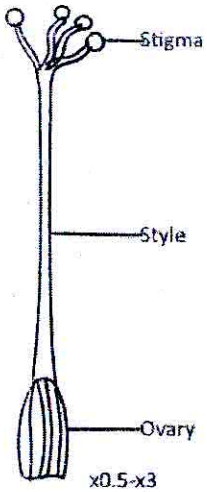


D-1.5
L-1.5
M-0.5
T-0.5
N-0.5
T=04.5

N/A-if wole flower is drawn and labelled,if receptacle is drawn and labelled

ii) Remove the outer parts and expose the gynoecium of specimen **Y** (4mks)
Draw and label.

Drawing showing the Gynoecium of specimen Y



D-1.5
L-1.5
M-0.5
T-0.5
N-0.5
T-4.5

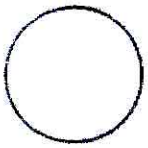
IRR=if cross section/ovules draw/whole flower is drawn

d) Observe the stigma of specimen X and Y .How are they adapted. (3mks)
i) **Stigma of X**

Has feathery stigma and forked stigma; which offers a large surface; to increase on the chances of pollen grains landing on;
Stigma of Y
Many stigma arms/heads to offer a large area for trapping pollen grains
Has lobed stigma; to offer a large surface area for insects to land/trapping/pollination;

e) i) obtain some pollen grains specimen **X** and mount it in a drop of water .view under the medium power of a microscope.
Draw one pollen grain that can be seen clearly .do not label. (2mks)

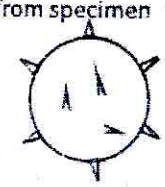
Drawing showing the pollen grain
from specimen X



S/smooth-01
Shape-01
Tittle-0.5
T-02.5

ii) Repeat the procedure and view the pollen grains from specimen Y under the medium power of a microscope.Without labeling, draw one pollen grain. **(02mks)**

Drawing showing the pollen grains
from specimen y



S/spiky-01
Shape-01
Tittle-0.5
T-02.5

iii) What is significance of the structure of each pollen grain? (06mks)

X

Small; which makes it light; with smooth surface; so that it can be easily carried off /blown by wind/without resistance from one flower to anthers

Y

Big /large; increase surface are for attachment onto the insects body
Spiky/spiny surface; stick on the insects' body/stigma

UACE BIOLOGY PAPER 3 2008

Question 1 **(69 minutes)**

You are provided with specimens Q which are freshly killed.

(a) Examine one of the specimens and state two external features in each case to classify the specimen into its phylum and class.

(i) Features for phylum (2marks)

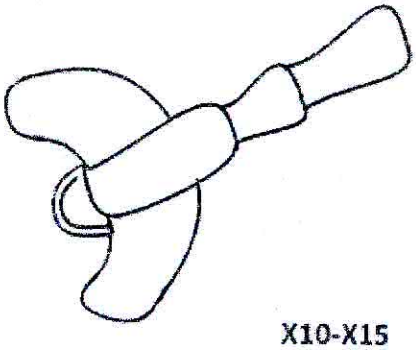
- *Exoskeleton/cuticle;*
- *Segmented body;* ***rej divisions***
- *Jointed appendages/limbs/legs;* ***rej segment limbs***

ii) Features for class.

- *Three main body divisions/Three body divisions/parts namely, head, thorax and abdomen;*
- *Three pairs of legs/limbs/ 6 legs;*
- *Three thoracic segments/thorax divided into three parts/segments(prothorax,mesothorax,metathorax);*
- *A pair of antennae;*

(b) Using a hand lens, examine the left compound eye of the specimen including the first three segments of one antenna, from the base.
Draw the structures observed. Do not label. **(05marks)**

A Drawing of the left compound eye and first three segments at the base of the antenna of specimen Q

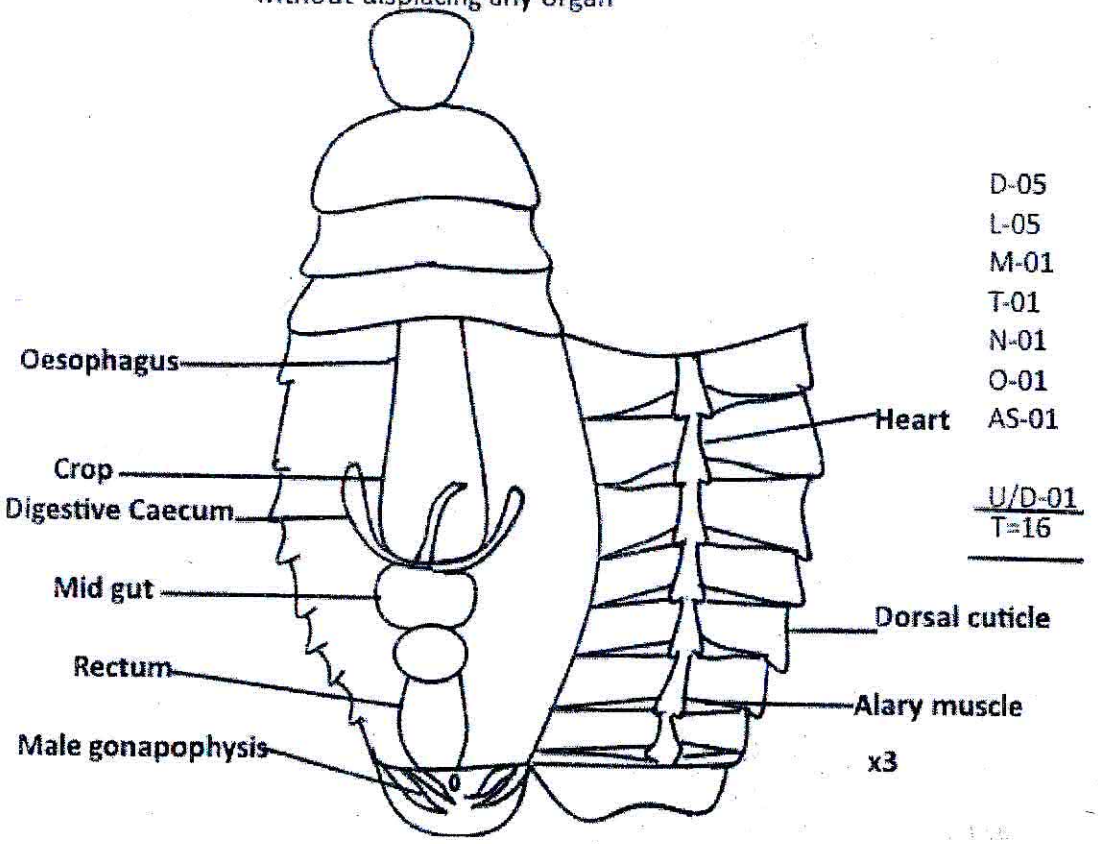


X10-X15

No. of segment-01
D-03
M-0.5
N-0.5
T=05

(c) (i) pin one specimen Q with the dorsal side uppermost. Dissect along the left lateral line of the abdomen. Displace the dorsal cuticle and clear any fat tissue. Without displacing any other structures, draw and label your dissection. (16marks)

Drawing showing exposed structures in the abdominal region of specimen Q without displacing any organ

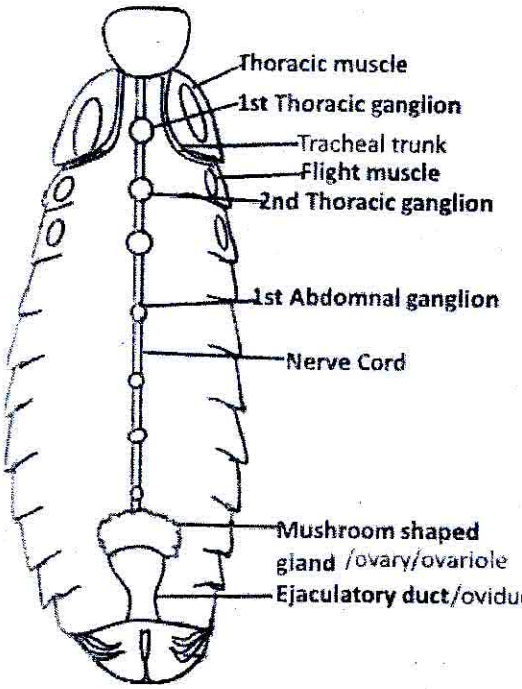


D-05
L-05
M-01
T-01
N-01
O-01
AS-01

U/D-01
T=16

(ii) By further dissection, cut and remove the whole alimentary canal to clearly display the structures on the ventral cuticle (keep the alimentary canal for question2).Draw and label the structures associated with the ventral cuticle, anterior to the last abdominal segment.

A Drawing of structures on the ventral cuticle of specimen Q anterior to the last Abdominal segment without the alimentary canal.



D-3.5
L-3.5
M-01
T-01
N-01
O-01
T=11

N/A=If any structure on the last abdominal cuticle is drawn and labelled. e.g gonapophysis,style. if head or any of its parts are drawn and labelled
IRR=IF alimentary canal is included

X1-X4

QUESTION 2

Solution **P_1(from soak bean seeds),P_2(from white sweet potato) and P_3 (from newly ripe orange)** are extracts of different plant organs .carry out the following tests in **tables 1, 2,3** and 4 to determine the nutrient content of each solution. Record your tests and observations in the tables.

i)**Benedict's test Table 1**

Test		*Observations*
To 1 / 2 cm^3 ;of solution in the test tube was added 1 / 2 cm^3 ;Benedict's solution ;and boil;	P_1	*Turbid solution turns to pal Blue solution which persisted on boiling;*
	P_2	*Turbid solution turns to pal Blue solution which on boiling turns to green solution/yellow ppt;*
	P_3	*Turbid solution turns to pal Blue solution which on boiling turns to green solution then to yellow ppt/orange ppt/brown precipitate;*

ii) Biuret test **Table 2**

Test		*Observations*
To 1 / 2 cm^3 ;of solution in the test tube was added 1 / 2 cm^3 ;NaOH solution/aq followed by 2/4 drops; of $CUSO_4$ solution;	P_1	*Turbid solution turns to Intense/deep purple solution/violet purple solution;*
	P_2	*Turbid solution turns to Pale purple solution/pale blue solution;*
	P_3	*Turbid solution turns to Pale blue solution;*

iii) Iodine test **Table 3**

Test		*Observations*
To 1 / 2 cm^3 ;of solution in the test tube was added 1 / 2 cm^3 ;drops of iodine solution;	P_1	*Turbid solution turns to Pale black /specks of blue-black solution*
	P_2	*Turbid solution turns to Blue-black solution/black solution*
	P_3	*Turbid solution turns to Pale brown/yellow solution*

iv) DCPIP test **Table 4**

Test		*Observations*
To 1 / 2 cm^3 ; of DCPIP solution; in the test tube was added drop wise food solution;	P_1	*Blue colour persited*
	P_2	*Blue colour persited*
	P_3	*Blue solution turns to colourless solution*

b) From your results suggest the plant parts that the solutions were obtained .explain your answer.

(04mk)

	Reasons
P_1	***Seed** has /stores much proteins and little starch*
P_2	***Root tuber/stem tuber** --has/stores much starch and little reducing sugars*
P_3	***Fruit** has /stores much ascorbic acid/vitamin C and much reducing sugars.*

c) Dissect the two specimens of **Q/cockroach,** remove the alimentary canal and cut out the fore gut and mid guts. put both the mid gut and fore gut in s mortar, grind into a fine paste and add 3cm^3 of water .stir ,leave to settle and decant to obtain extract **C** .divide the extract equally into three test tubes labeled as P_1, P_2,P_3.

To test tube P_1 add 3cm^3 of solution P_1, **to test tube** P_2 add 3cm of solution and to test tube P add 3cm of solution. Incubate the test tubes at 35-40^{0}C for 20 minutes .after incubation; carry out the tests in table 5 on the contents of each test tube to establish the effect of extract **C on solutions** P_1, P_2 ,P_3

I). Record your observations in the table. **(09 marks)**

Table 5

contents	**Observations after 20 minutes**		
	Biuret test	Iodine test	DCPIP test
Of test tube P_1	*Pale purple/ blue solution;*	*Pale black solution/ very few specks of black particles/ pale brown solution;*	*It remains blue/pale blue*
Of test tube P_2	*Pale purple/blue/violet solution;*	*Moderate blue-black/pale blue-black solution/pale brown/yellow solution*	*It remains blue/pale blue*
Of test tube P_3	*Blue solution;*	*Turns pale brown/ yellow solution*	*Blue colour is decolourised/cleared*

ii).Explain your results of the tests with the contents of
Test tube P_1
*Amount of starch greatly reduced with little reduction of protein content. **Extract C** has enzymes that catalysed the hydrolysis of starch completely/partially catalysed the hydrolysis of proteins or does not catalyse the breakdown of proteins (if protein content remained the same in the table above*

Test tube P_2
*The amount of starch greatly decreased/absent and the amount of proteins reduced or absent/remains the same. Extract **C** has enzymes that catalysed the breakdown of starch but not proteins or has little proteins (if table 2 no proteins but table 5 has proteins*

Test tubeP_3
Amount of vitamin C in table 4 and 5 remains the same since there is hydrolysis of Vitamin C by the enzyme in solution C

iii).From your results in (c) (i), state two properties of the active substance in extract C.

- *its specific in action*
- *catalysed the hydrolysis of starch and proteins*
- *the active substance/enzyme catalysed the breakdown of proteins and starch in a temperature range of **35-40 ^oC***

QUESTION 3 **(52 MINUTES)**

Specimens **R** (panicum maximum inflorescence), **S** (bidden pilosa inflorescence) and **T** (maize inflorescence) are inflorescence .examine the specimens using a hand lens where necessary.
a) Describe the structure of the inflorescence and flowers of each specimen.

i) Specimen R
Structure of the inflorescence (4mks)
Has main axis/peduncle/rachis with lateral branches of variable length reducing upwards towards the apex; attached oppositely/whorly/alternately having many florets/flowers/spikelets.
***some spikelets** are single/in groups of 2/3 all having stalks which are of varying length attached alternately on the peduncles and lateral branches/main axis terminating into a spikelet.*

Structure of the flowers
Each spikelet is stalked and has two florets which are enclosed by bracts, outer being tough/ hard, thick, smooth, parallel veined, dark coloured and curved in wards/boat shaped and tapering towards the apex. While inner bracts are thin /membranous/papery and boat shaped.
The florets are bisexual; stamens, consisting of long, thin and slender filaments with large; elongated; bilobed anthers which are loosely attached.
*The **pistil** has a superior ovary and short style which bears two/forked, feathery stigmas.*
Such stigma provided a large surface area for easy trapping of pollen grains in air making pollination easy. The spikelets (florets) have zygomorphic symmetry or are irregular.

Specimen S **(4mks)**

Structure of inflorescence

It has numerous; crowded; sessile florets which are attached onto a flattened /cup shaped/expanded apex of the peduncle/central main axis with a concentric/radial/circular pattern of floret arrangement.
It has two types of floret the tubular/disc floret at the centre surrounded by ray/regulate floret on the outer side covered by /surrounded by involucres of bracts. The numerous, sessile inner florets/disc/tubular florets are arranged in the circular pattern around the centre and closely packed.
'The ray (ligulate) florets are zygomorphic and found at the peripheral of the expanded apex of peduncle.
It consists of broad/open petals at the apex which are tubular at the base.

Structure of flowers

Two types of floret occur, both sessile with fused corolla/petals. The ray/outer florets/ligulate floret having flattened/broad open corolla at apex and tubular at the base; zygomorphic/irregular, free spiny sepals.
The disc/tubular floret are bisexual, Actinomorphic; with five fused tubular petals, free spiny pappus/sepals/calyx. Pistil with long/elongated inferior ovary and forked stigma. It has five stamens with fused, bilobed, elongated/long anthers and short filaments, with regular symmetry.

iii).specimen T. **(4mks)**

Structure of inflorescence

It consists of a main axis/peduncles/rachis in which numerous paired, one stalked other sessile; filaments are alternately/spirally attached to the peduncle. Each branch bears numerous and paired spikelets which are also alternately attached to the branches .The spikelets in the pair .one is stalked/asessile and the other is sessile/unstalked.

Structure of flowers

*The spikelets (florets) are alternatively attached to the peduncles and irregular. Each spikelet bears two florets which are covered by bracts. The outer bracts are hairy, thick; parallel veined; hard/tough and curved/ boat shaped, tapering towards the apex while the inner bracts/**Palea** are membranous/thin, smooth, curved in wards and occur in pairs .both inner and outer bracts are parallel veined and dark coloured.The florets are unisexual with only stamens, consisting of thin, long, flexible and slender filaments each bearing large, grooved or dangling, elongated bilobed anthers.*

c) State one advantage and one disadvantage of the structural arrangement of the flowers of specimens R and T. **(2 mks)**

i)R

Advantages

- *Alternate arrangement exposes the florets for easy pollination.*
- *The long nature of filaments exposes the anthers hence making pollination easy.*
- *The loose attachment of anthers to the filament makes pollination easy.*
- *The large anthers produce numerous pollen grains that make pollination easy.*

Disadvantage

- *Floret arrangement or spikelets makes the inflorescence large or conspicuous to the herbivores for easy predation.*
- *Crowded/packed/close to each other making it conspicuous increasing chances of being eaten.*
- *Crowded/packed for easy/fast spread of diseases/infections/pests*

ii)T

Advantages

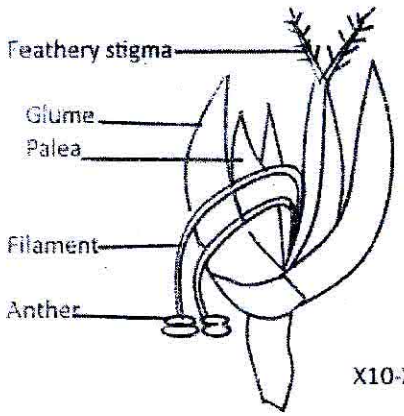
- *Packed/crowded resulting in production of large quantities of pollen grain/increasing chances of pollination*
- *Packed/crowded for support*

Disadvantages

- *Packed making it conspicuous for easy predation*
- *Packed making spread of diseases/infection easy*

c) Using a hand lens, example one flower of **specimen R** displacing some structures where necessary to expose all parts. Draw and label.

Drawing showing one flower of specimen R



X10-X15

UACE BIOLGY PAPER 3 2007

QUESTION 1

You are provided with **specimen T** which is freshly killed.

(a) Pin the specimen with the ventral side uppermost. Dissect and remove the skin, taking note of how it is attached to the underlying body wall.

(i) Describe the attachment of the skin to the body wall. **(3marks)**

The skin is firmly attached; to body wall at the pectoral/pelvic region /fore /hind limbs; and throat region; while loosely attached within the abdominal region/lower trunk region;

(ii) Suggest the significance of the way the skin is attached to the body wall as described in (a) (i) above. **(3mark)**

Firm attachment helps to support/hold the skin on to the body of the animal;
Loose attachment creates a fluid filled space; to facilitate gaseous exchange/dissolve respiratory gases;

(b) Observe the main blood circulation on the skin.

(i)Describe the pattern of blood circulation on the skin. **(4marks)**

One/two main blood vessel(s)/musculo-cutaneous vein(s); from attachment of fore limbs; big sized; branches; to form a network/into many smaller blood vessels/capillaries; spread allover the skin;

(ii)Give the significance of the pattern of blood circulation described in (b) (i). **(3marks)**

Forms a network to increase the surface area; for increased gaseous exchange/diffusion of gases; to increase transport/flow /draining of blood away from the skin; leading to increased gradient/diffusion of gases;

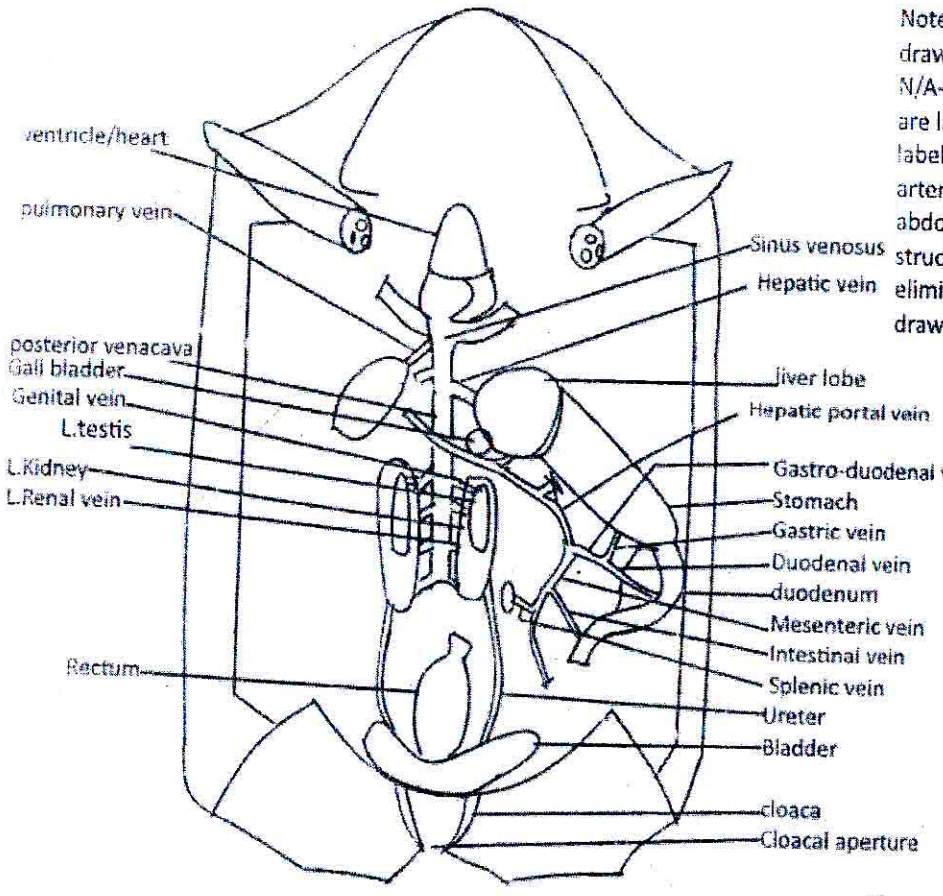
(c) Dissect the specimen further to display:

(i) Blood vessels carrying blood from organs located on the left half of the abdominal cavity back to the heart.

(ii) Structures used for elimination of unwanted materials from the body.

With the heart displaced anteriorly, draw and label the blood vessels and structures displayed in (c) (i) and (ii) on one diagram. **(27marks)**

A Drawing of blood vessels carrying blood from organs located on the left half of the abdominal cavity back to the heart and structures used foe elimination of unwanted materials from the body of specimen T with the heart displaced anteriorly



x2

Note:zero marks if two drawings are made
N/A-if viens on the right are labelled,arteries are labelled Pulmonary artery and arteries in the abdomen are labelled structures not for elimination of wastes are drawn and labelled

D-11	
L-11	
T-01	
N-01	
O-01	
HT/D-01	
I/S-01	
T=28	

QUESTION 2 **(69minutes)**

You are provided with specimens **P** (sprouting Irish potato) **and Q** (fresh Irish potato) and solutions **X(2M NaOH), Y(2M HCl) and Z(1% H_2O_2)**. using the solutions, you are to carry out tests on the specimens. Peel specimen **Q then cut** from it four cubes of measurements and label as indicated below.

0.5 cm x 0.5cm x 0.5 cm, label **K**.
1.0 cm x1.0 cm x1.0 cm, label **L**.
1.5 cmx1.5 cm x1.5 cm, label **M**.
2.0 cm x2.0 cm x 2.0 cm, label **N**.

Prepare an extract from each cube as follows:
Grind the cube in a mortar into a paste then add $10cm^3$ of distilled water stir, leave to settle and decant. Label each extract accordingly.

(a) Label four test tubes as 1, 2, 3 and 4 and add contents to each as shown in table 1.Record your observation and deductions in the table. **(6marks)**

Table 1

Test tube	Contents	Observations	Deductions
1	2cm3 of Z and 2cm3 of K	*Few/little ;bubbles/effervescence;*	*Z broken down slowly/slow activity of the enzyme;*
2	2cm3 of Z and 2 cm3 of L	*Moderate/ no of; effervescence/bubbles;;*	*Z broken down moderately/moderate activity of the enzyme;*
3	2cm3 of Z and 2 cm3 of M	*Rapid/fast/many; effervescence/bubbles;*	*Z is broken down rapidly/fast/fast activity of the enzyme*
4	2 and of Z and 2cm3 of N	*Very fast/very rapid/very many; effervescence; bubbles;*	*Z is broken down very fast/very fast activity of the enzyme;*

(b) Use extract N to carry out further tests in Table 2.Record your observations and deductions in the table. **($04^1/_2$ marks)**

Table 2

Tests	Observations	deductions
(i) To 2 cm3 of Z add 2 cm3 of N that has been boiled for 5 minutes and cooled.	*No bubbles/ effervescence;*	*Z is not broken down;*
(ii) To 2 cm3 of Z add 2 cm3 of N followed by 2 cm3 of X.	*Fast /many; effervescence/bubbles;*	*Z is broken down/high activity of enzyme;*
(iii) To 2 cm3 of Z add 2 cm3 of N followed by 2 cm3 of Y.	*No /few/little; bubbles/ effervescence;*	*Z is not broken down/no/slow activity of enzyme;*

(c) Explain your results.

(i) In table 1 **(6marks)**

The extracts contained the active substance/enzyme /catalase; the smallest cube (K); had the least/lowest concentration of enzyme; thus had the lowest/least rate of breakdown of Z/lowest enzyme activity;

***Cube L** is moderate in size; and had moderate concentration of enzyme; thus had moderate rate of decomposition of Z/enzyme activity;*

***Cube M** is big in size; and had high concentration of enzyme; thus high rate of breakdown of Z/enzyme activity;*

***Cube N** is the biggest; so has the highest concentration of enzyme; and highest rate of breakdown of Z/enzyme activity;*

(ii) In Table **2**

Boiling denatures the active substance/enzyme; so no activity;
Solution X provides suitable medium for/favors/promote enzyme activity;
Solution Y inhibits/ provides unfavourable medium for/does not favour enzyme activity

(iii) From the tests in Tables 1 and 2, state the factors that were being investigated. **(3marks)**

The effect of enzyme concentration on enzyme activity/catalysed reaction;
The effect of excessive heat/boiling/high temperature on enzyme activity;
The effect of inhibitors on enzyme activity; ***rej PH***

d) Peel specimen **P** and from it cut a cube of 1.0 cm x 1.0cm x 1.0 cm and make an extract from it in the same way you prepared earlier extracts. Label the **extract P.**

i) Carry out the following tests to determine the relative abundance of starch, reducing sugar and proteins in extracts **P and L** prepared in (2a).

ii) Record your observations and deductions for each extract in Table 3

Table 3

Tests		**Observations**	**conclusions**
Starch test *To 2cm^3; of **P/L** add 1/2/3 drops; of iodine solution;*	***P***	*The turbid suspension turned Brown/yellow colour of iodine solution /specks of blue-black observed.*	*No/Little ;starch present;*
	L	*Turbid solution turns Blue-black solution;*	*Much; starch present;*
Reducing sugar test: *To 2 cm^3 ;of **P/L** add 2 cm^3 ;of Benedict's solution; and boil;*	***P***	*The turbid suspension turns blue and then the colour changes from blue to green to yellow to orange precipitate;*	*Little/Moderate /much ;reducing sugar present;*
	L	*The turbid suspension turns and solution remains blue;*	*No /Little; reducing sugar present;*

Protein test: *To 1 cm^3; of P/L add 1cm^3; of sodium hydroxide solution; then 2/3 drops ;of copper sulphate solution;*	P	*Turbid suspension turns Pale purple/pale violet colour observed.*	*Little ;protein present;*
	L	*Turbid suspension turns purple/violet colour observed.*	*Much ; protein present;*

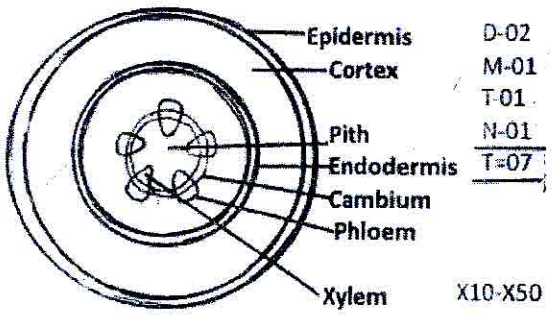
(ii)Explain any differences between the contents of P and L observed in table 3

*As sprouting /germination occurs in **P**; starch is hydrolyzed to reducing sugars; for energy production/for growth and development; while proteins are hydrolyzed and used /broken down; for tissue formation/growth and development; The stored food in **N** was not hydrolyzed;*

Question 3

You are provided with specimen **S**(***Herbaceous dicot stem***). Cut three thin cross –sections from it and immediately transfer them into a Petri dish of water.
Mount one section in a drop of acidified phloroglucinol on a slide and cover with a cover slip. Observe under low power of a microscope.
(a) (i) Draw and label the tissue plan of the section of specimen S. **(07$^1/_2$marks)**

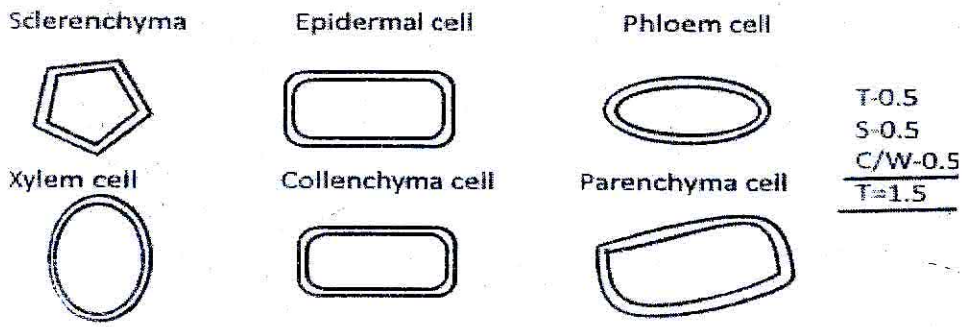
Drawing of the tissue plan of the section specimen S



D-02
M-01
T-01
N-01
T=07

X10-X50

(ii)Draw the structure of one cell from each tissue type found in the section. **(4marks)**



T-0.5
S-0.5
C/W-0.5
T=1.5

(b) Identify the stained tissue in the section of **specimen S.** **(1 mark)**

Xylem OR *Sclerenchyma*

(i) Giving reasons, state the major group of plants to which specimen S belongs. **(3marks)**
Dicotyledoneae/dicotyledonous/Dicotyledon;
Reasons:

- *Vascular bundles arranged in a circular/ring pattern in the stem;*
- *Presence of cambium;*
- *Presence of a central pith;*
- *Presence of endodermis,*
- *Presence of xylem towards the inside and phloem towards the outside of the stem.*

(ii) Give structural adaptations of the coloured tissue for its function. **(2marks)**

- *It is composed of thick walled cells for support/to prevent collapse/mechanical support*
- *Lignified for support;*
- *Composed of cells with lumen for passage of material/ water*
- *Composed of cells with narrow lumen to facilitate capillarity;*

UACE BIOLGY PAPER 3 2006

Question 1
a) You are provided with specimen **R (Toad).** Classify it into the following.

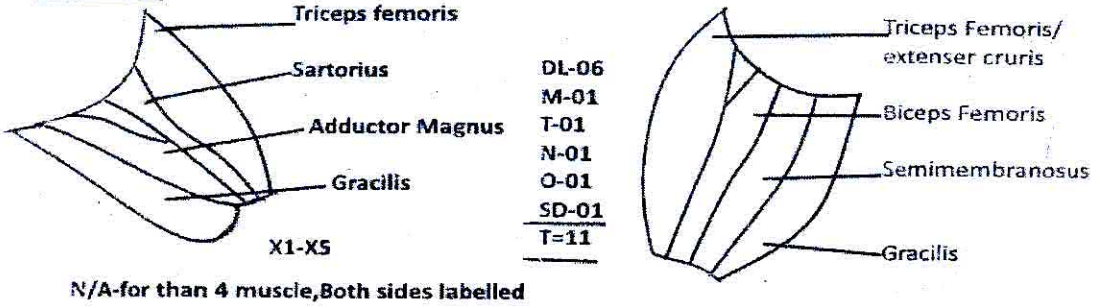
Kingdom: *animalia*
Phylum: *chordata*
Class: *amphibia*

b) Observe the head of the specimen and state how it is adapted to its habitat. **(3.5mks)**

- *Its triangular shaped/streamlined/ tapers anteriorly/dorso-ventrally flattened to (ease) swimming/burrowing.* ***Or*** *The head tapers anteriorly to provide a streamlined body to reduce air resistance during locomotion.*
- *Large protruding/dorso-laterally located eyes for wide field of view/better view/clear seeing.*
- *Large mouth to provide a wide gape for capturing/ingesting prey of large size.*
- *Eyes are dorso-laterally located to maintain aerial contact when the body is submerged in water.*
- *A pair of naris/nares/small holes/nostrils located at the tip of head/snout to ease breathing on land/when submerged in water.**rej** gaseous exchange/help in breathing*
- *.flat ear drum/tympanic membrane to allow for streamline shape **or** it's being circular gives it a wide surface area for receiving sound waves and It is a stretched membrane to easily vibrate upon receiving sound waves to make hearing easy.*
- *The nictitating membrane for protection of the eye from mechanical injury during swimming/ borrowing.*
- *Patched/grey/green/brown/dull coloured skin for camouflage /poison glands for protection.**rej** black*

b) Dissect specimen **R** to display the main superficial muscles of the left thigh of the specimen. Draw and *label the muscles.* ***(09 marks)***

Drawing of superficial muscles of the left thigh of the specimen R **dorsal view**
ventral side



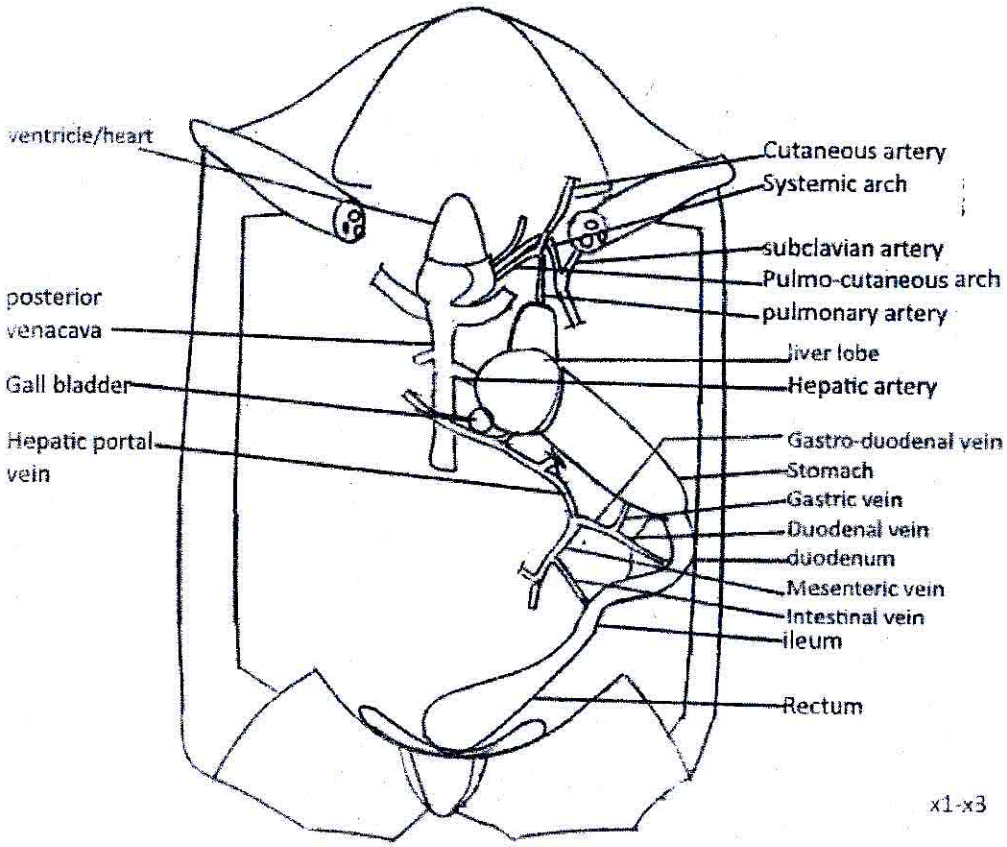
X1-X5

DL-06
M-01
T-01
N-01
O-01
SD-01
T=11

N/A-for than 4 muscle,Both sides labelled

d) Continue to dissect the specimen to display:
i) The Blood vessels that drain blood from the alimentary canal and its associated organs back to the heart, with the alimentary canal displaced to your right and the heart turned upwards and pinned through the ventricle.
ii) Blood vessels that take blood from the heart to the thoracic region of the animal. Draw and label your dissection showing (i) and (ii) on one diagram. (26mks)

Drawing of Blood vessels that drain blood from the alimentary canal and its associated organs and the blood vessels that take blood from the heart to the thoracic region of specimen R with the heart turned upwards and pinned through the ventricle.



DLA-05
DLV-11
M-01
T-01
N-01
OS-01
Ob-01
S/D-01
HT-02
T=24

x1-x3

Question 2 ***A 1.0M).; B (0.8M); C (0.5M);, D (0.3M),; E (0.1M), ;and F (0.0)***

You are provided with **specimen P** (large Irish potato) and sugar solutions of varying concentrations labeled **A, B, C, D, E and F.**

(a). measure 8.0cm^3 of each solution and transfer the solutions into test tubes labeled Correspondingly. Using a cork borer, obtain six equal sized cylinders of at least 1cm diameter from **specimen P** and trim the cylinders to uniform length of 6.0cm. Immerse a cylinder into each of the solutions in the test tubes and leave for **$1^1/_2$ hours.**

(i) After **$1^1/_2$ hours.**, transfer solution **A** into a measuring cylinder and record the final volume in table below.

Repeat the procedure for the remaining solutions **(6mks)**

Solutions	A	B	C	D	E	F
Final volume/cm^3	**9.0-8.5**	**8.8-8.4**	**8.6-8.1**	**8.3-7.8**	**7.9-7.4**	**7.6-7.0 =X**
Initial Volume: final volume ratio	**8.0/X** **1:0.89-0.94**	**8.0/X** **1:0.91-0.95**	**8.0/X** **1:0.93-0.98**	**8.0/X** **1:0.96-1.03**	**8.0/X** **1:1.01-1.08**	**8.0/X** **1:1.05-1.14**

(ii) Calculate the initial volume to final volume ratio, of the solution in the spaces provided in the table above.

b) Suggest the solution with the concentration nearest to that of the cell sap of specimen P. explain your answer. **(6mks)**

Solution D ;(*C, D, E in relation to results)*

the initial and final volumes of the solution remains the same/closest to the original volume; giving a ratio of 1:1/nearest to 1:1 meaning no net movement of water into or out of the plant tissue;

(ii). Arrange solutions A to F in order of decreasing osmotic potential

Explain your answer. **(6mks)**

F ,E ,D ,C ,B ,A/ (F > E > D > C >B >A).F *has highest tendency of water to move out; thus lost most of the water to the cell sap of the cylinder/greatest decrease in volume/is most dilute; followed by* ***E****;in that order.* ***A*** *has the lowest tendency to lose water/gains most water/greatest increase in volume/is the most concentrated.*

(c) Explain the results obtained in test tubes A, D and E. **(9mks)**

Test tube A

Solution *A* *is hypertonic/more concentrated to the cell sap of the cylinder; water is lost from the cell sap of the cylinder by osmosis/exosmosis; and gained by the external solution causing the volume of the solution to increase;* ***(03marks)***

Test tube D

Solution D is isotonic/same concentration to the cell sap of the cylinder; net water gain is equal to water loss in the cell sap of the cylinder/no net change in volume of solution; ***(03marks)***

Test tube E

Solution ***E*** *is hypotonic/less concentrated to the cell sap of the* ***cylinder;*** *water is gain from the cell sap of the cylinder by osmosis/endosmosis; and lost by the external solution causing the volume of the solution to decrease;* ***(03marks)***

d) Examine the cylinders placed in solutions **B and F**

(i) Compare the physical conditions of the cylinders from solution **B and F. rej** flexible/flaccid/spongy

Table II

From solution B	From solution F
1.shorter/narrower/decreased in length	*Longer/wider/increased in length*
2.shrunken/decreased in volume	*Swollen/ bigger/increased in volume.*
3.flabby/soft	*Turgid/hard/stiff/firm/rigid*
4.smooth texture	*Rough/coarse texture*

(ii) Suggest the ecological significance of your observations in (d) (i) in the life cycle of **specimen P**

- *Turgidity gives support herbaceous plants/causes them to be upright for photosynthesis.*
- *Turgidity enables plant to store water/stomatal opening for gaseous exchange.*
- *Flabby tissues lead to dormancy of the stem tuber leading to dropping/wilting which reduces surface area for water loss/reduction of photosynthesis*
- *Flabby nature leads to wilting of plant leaves to reduce water loss.*

Question 3

You have been provided with specimens **S (spirogyra)**and **T(rhizopus/mucor/mould).**

a) Examine the specimens using a handless and classify them from kingdom to genus level. (05marks)

Taxonomic group	Specimen S	Specimen R
Kingdom	***protoctista***	***Fungi***
Phylum	***chlorophyta***	***Zygomycota***
Class	***chlorophyceae***	***zygomycetes/phycomycetes***
Order	***zygnematales/conjugales***	***zygomycetales/murales***
Genus	***spirogyra***	***Rhizopus/ mucor.***

b) Mount a few filaments of specimen **S** in a drop of water on a slide and cover with a cover slip. Examine under medium power of a microscope

i) Give two structural characteristics of specimen **S** **(02marks)**

Spiral chloroplasts; cells joined end to end (lengthwise)/septate to make a filament; prominent continuous cell wall; circular pyrenoids within the chloroplasts; peripheral cytoplasm/thin cytoplasm; large cell vacuole;

ii) Observe the specimens and state the type of nutrition that occurs in each of the specimens **S and T,** giving a reason **(02marks)**

Type of nutrition for **S**

- *Autotrophic nutrition/photosynthetic/holophytic/photoautotrophic*

Reason

- *It has chlorophyll/green in colour; **rej has chloroplasts***

Type of nutrition for **T**

- *Heterotrophic nutrition*

Reason

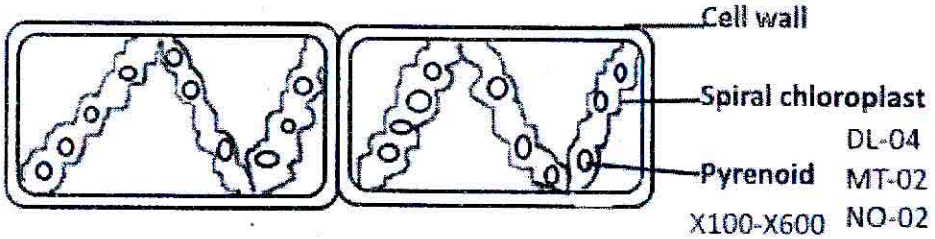
- *It lacks chlorophyll/green in colour; **rej saprophytic***

iii) Give four structural features which enable specimen **S** to survive in its habitat (04marks)

- *Long filamentous for increased surface area for absorbing sun light for photosynthesis.*
- ***The cells are joined end to end to ease fragmentation** or sexual reproduction and for flexibility.*
- *It has long spiral chloroplast to increase surface area trapping sun light for photosynthesis.*
- *It is a thin filament for easy floating on water.*
- *It has numerous pyrenoids to store much food.*
- *It has thick cell wall for protection.*
- *Septate for flexibility*

iv) Draw and label two cells of **S** that you can see clearly. **(06 marks)**

A drawing of one cell of specimen S under medium power of a microscope.



c) Remove a small portion of specimen **T** and examine it under medium power of a microscope.

i) Name and describe four major vegetative parts of **specimen T in table ii**

Part	**Description**
Sporangium/spore capsule;	*Round/swollen/spherical/dull /black head;*
Sporangiophore;	*Thin/slender/long*
Rhizoids/rooting hyphae	*Numerous/thin/slender*
Stolon/linking hyphae	*Thin/thread like/slender/forms network/extensively branched;*

ii) From the descriptive features in **table 2** State how any two parts are adapted to their functions? (02marks)

• *Sporangium/spore capsule –storage of spores;*
• *Long Sporangiophore-spore dispersal/ease sporulation*
• *Rhizoids/rooting hyphae-penetrate into substratum to absorb nutrients/for anchorage/large surface area for absorption of nutrients.*
• *Stolon/linking hyphae-network for support /transport nutrients/wide coverage;*

III) For survival in its habitat, state one advantage

i) specimen **S has over T** (01 marks)

S has spiral chloroplasts/chlorophyll for sunlight absorption for photosynthesis;
Septate for fragmentation/asexual reproduction;
Many Circular Pyrenoids for food storage;
Filamentous for large surface area too absorption of sun light;

ii) specimen **S has over T** (01 marks)

T *has* *rooting hyphae to absorb readymade nutrients;*
Bears sporangia containing spores which are easily dispersed by wind;
Long sporangiophores for carrying sporangia high to ease dispersal of spores;

e) From the structural characteristics of **S and T**, classify the specimens according to the groups in table **3**

	Phylum	Class
Specimen **S**	***Chlorophyta;***	***Chlorophyceae;***
Specimen **T**	***Zygomycota;***	***Zygomycetes;***
	Mycophyta; ***Eumycophyta;***	***mycetes /phycomycetes;*** ***phycomycetes;***

UACE BIOLGY PAPER 3 2005

Question 1

You are provided with specimen **P** (toad)

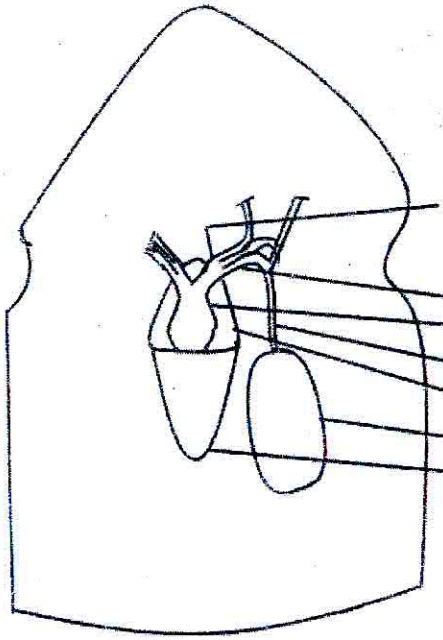
a) Examine the specimen and give five observable adaptive features that enable the specimen to survive in its habitat. **(05mks)**

- *Dorso-laterally positioned/large/round and protruding /bulging eyes for wide vision;*
- *Long/muscular hind limbs for propulsive force/forward thrust when jumping/swimming/locomotion*
- *Head tapering anteriorly/pointed/triangular to provide a streamlined body for reduced resistance during locomotion.*
- *Digits/toes of hind foot have a web between them to increase the surface area for swimming.*
- *It has a wide gape/opening of the buccal cavity for consuming/ ingesting prey of large size.*
- *Small rounded opening located anteriorly for breathing/passage for gases/air when submerged in water.*
- *Large numerous poison glands for defense/protection/to be unpalatable.*
- *Many mucus secreting glands to moisten skin for gaseous exchange/temperature regulation*
- *Long/muscular hind limbs for propulsive force/forward thrust when jumping/swimming/locomotion*
- *Thin Nictitating membrane to protect the/moisten the eye.*

b) Dissect the specimen to display the:

i) Blood vessels taking blood to the left lung of the animal. Draw and label **(12 marks)**

Drawing of specimen P showing blood vessels taking blood to the left lung

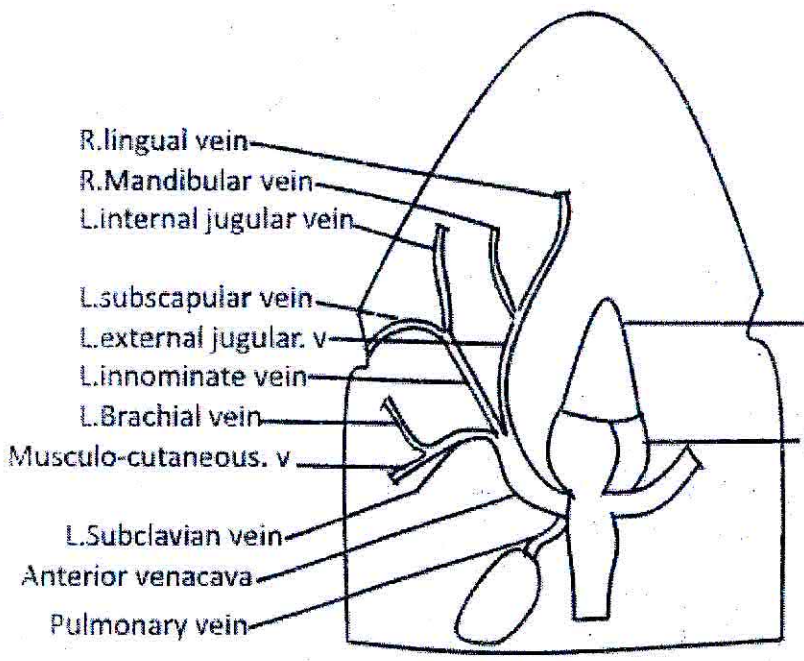


DL-07
M-01
T-01
N-01
O-01
SD-01
T-13

x1-x3

ii) Blood vessels returning blood from the right side of the head and chest region of the animal to the heart with the heart pinned anteriorly. Draw and label your dissection. (19mks)

Drawing of specimen P showing blood vessels returning blood from the side of head and chest region back to the heart.



DL-13
M-01
T-01
N-01
O-01
S-01
T=18

N/A =If posterior venacava drawn and labelled
N/A=if arteries drawn
N/A=if vein attached to truncus arterious

X3-x5

Question 2

Solution A=one day germinated sorghum
Solution B= three day germinated sorghum
Solution C= five day germinated sorghum
Solution D= seven day germinated sorghum
Solution E= one day germinated bean seeds
Solution F= five day germinated bean seeds

You are provided with solution **A, B, C and D** which extracts from seedlings of same type of seed at different stages of germination.

(a) Carry out an iodine test on each solution. Record your tests, observations and deductions in table 1 below.

Solution	Iodine	Observations	Deduction
A	*To 1 cm3 of solution A; was added 2/3 drops; of iodine solution;* ***(01.5mks)***	*Black solution*	*Much starch present*
B		*Blue-black solution*	*Moderate starch present*
C		*Deep blue /specks of blue-black solution*	*Traces of starch present*
D			

(b) Carry out a Benedict's test on each of the solutions **A, B, C and D**. Record your tests, observations and deductions in Table 2 below. **(07.5 marks)**

Solution	Benedict's test	Observations	Deduction
A	*To 1 cm^3 of solution A add 1 cm^3 of Benedict's solution and then boil*	*Blue/green solution*	*Blue-**no** Reducing sugars*
B		*Green/greenish-yellow ppt*	*Moderate starch present*
C		*Yellow /orange ppt*	*Much reducing sugars*
D		Green solution	Little reducing sugars

(c) Solutions E and F are exacts of seedlings of same type of seed, but different from seed types from which extracts A, B, C and D were obtained. Solution **E** is from seedlings of the same age as those from which extract A was obtained, while extract F is from seedlings of same age as of those from which extract C was obtained.

Carry out the following tests on solutions **A, C, E and F.**

Record your tests, observations and deductions in table 3 below.

Solution	Biuret Test	Observations	Deductions
A	*To 1cm^3 of Solution **A** add 1cm;^{3} of NaOH solution followed by 2/3 drops; of $CuSO_4$ solution;*	Blue solution;	Proteins absent;
C		blue Solution;	Proteins absent;
E		*Turbid solution turns to purple solution/violet;*	*Moderate Proteins present ;*
F		*Turbid suspension turns to pale purple solution*	*Little /trace of proteins;*

To 3 continued **Benedict's test**

E	*To 1 cm^3 ;of solution was added 2 cm^3; of Benedict's solution; and the boil;*	*Turbid Solution to blue solution*	*Reducing sugars*
F		*Turbid Solution to blue /turbid to blue/pale green solution*	*No reducing sugars/little Reducing Sugars present;*

(d) (i) From your results in Table 1 and 2, arrange the solutions **A, B, C and D** in order, starting with solution from the youngest seedlings and ending with that from the oldest seedlings. (01mks)
A; B; C

ii) Give reasons for your answer in (d)(i)

Because the amount of starch decreases from solution A-C while reducing sugars are increasing; since starch is being broken down/hydrolyzed into reducing sugars; **rej converted or changed**

(e) (i) From your results in Table 3 compare the contents in solution **A** and **E** and contents in solution **C** and **F**
***A and C** has no proteins;*
***E and F** have proteins and some reducing sugars;*
ii) Explain your results in table 3
*Seedling from which extract **A and C** were obtained do not store proteins; while seedling from which **E** and **F** were obtained store mainly proteins; and some carbohydrates;*
As germination proceeds some of the stored carbohydrates are hydrolyzed into reducing sugars (F); and stored proteins are broken down/used up as germination progresses;

Question 3 Q (maize flower), R (panicum maximum/guinea grass),S (lantana camara),T (commelina) and U (Bidden pilosa)

Specimens **Q; R; S; T and U** are reproductive parts of different plants.
a) Remove one of the outer most flowers one flower from the middle part of specimen U.Using hand lens examine the two flowers and state two differences between them. (2mks)

Ray/ligulate floret	Tubular/Disc floret
• *Open corolla towards apex/tubular at the base only*	*Tubular corolla*
• *Zygomorphic/irregular*	*Actinomorphic /regular*
• *Style/stigma/ovary/anthers absent*	*Style/stigma/ovary/anthers present*
• *Corolla white in colour*	*Corolla yellow in colour*

b) i)Using a hand lens examine a flower from each of specimens **Q and R.** Describe the structure of each flower.

Flower from Q. (4mks)

*Outer bracts/glume present are thick; rough/hairy; hard/tough/stiff and curved/boat shaped, Inner bracts/**Palea** are membranous/thin; smooth; curved in wards and occur in pairs . Both inner and outer bracts are parallel veined and dull coloured enclosing stamens only with thin ;flexible;enlongated/long filaments and large,bilobed anthers which hang outside/loosely attached: free stamens; alternating spikelet's from pedunicle.florets are paired.*

Flower from R.

Each spikelet is stalked and has two florets which are enclosed by bracts, outer being tough/ hard, thick, smooth, parallel veined, dark coloured and curved in wards/boat shaped and tapering towards the apex. While inner bracts are thin /membranous/papery and boat shaped.
The florets are bisexual; stamens, consisting of long, thin and slender filaments with large; elongated; bilobed anthers which are loosely attached.
*The **pistil** has a superior ovary and short style which bears two/forked, feathery stigmas.*
Such stigma provided a large surface area for easy trapping of pollen grains in air making pollination easy. The spikelets (florets) have zygomorphic symmetry or are irregular.

i) State one **advantage of specimen Q** in reproduction. **(02mks)**

- The large anthers produce numerous pollen grains that make pollination easy.
- The loose attachment of anthers to the filament makes pollination easy.
- The long nature of filaments exposes the anthers hence making pollination easy.

ii) State one advantage of specimen **R over specimen Q** in reproduction. **(02mks)**

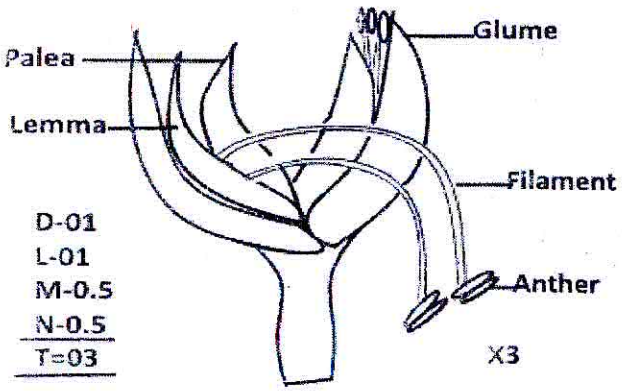
***R** is bisexual/hermaphrodite and therefore capable of self pollination/see formation/fertilization **while Q** is unisexual and therefore requires another flower of opposite sex for reproduction to occur.*

iii).How is specimen **R** adapted for pollination? (04mks)

- Has both stamens and pistil/carpel therefore pollen produced by stamen and deposited easily on stigma
- Elongated/long/flexible filaments to expose anthers
- Two stigmas heads/forked feathery stigma to capture /trap /avail large surface area for pollen;
- Loosely attached anthers to easily shake off pollen;
- Large anther heads to produce large quantities of pollen to increase chances of pollination

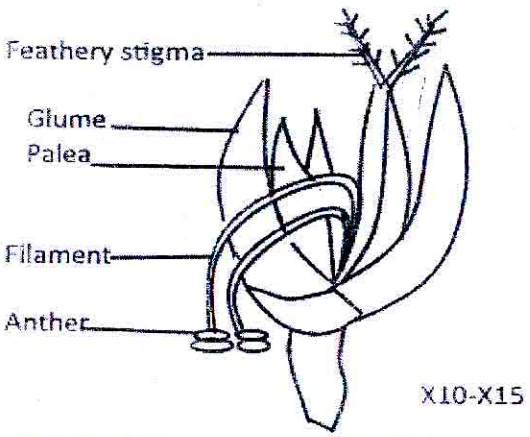
c) Open up one flower from each of specimens **Q and R.** Draw and label each flower in the space in the space provided. **(4mks)**

Drawing showing flower from Q



D-01
L-01
M-0.5
N-0.5
T=03

Drawing showing one flower of specimen R



d) Construct a dichotomous key to identify specimen **Q, R, S, T and U.** **(08mks)**

1a) Bisexual floret ..... ***go to 2***
1b) Unisexual floret..... ***Q***
2a) specimen with superior ovary..... ***go to 3***
2 b) Specimen with superior ovary..... ***U***
3 a)has petals..... ***go to 4***
3b) lacks petals ..... ***R***
4 a) Free petals..... ***T***
4b) Have petals fused..... ***S***

UACE BIOLGY PAPER 3 2004

QUESTION 1. You are provided with specimens **K** (cockroach)
a) Examine the specimen and name the external features which are characteristic of the class to which the specimen belongs **(3mks)**

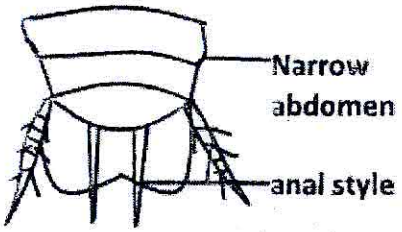
- *three main body parts(head, thorax and abdomen),*
- *three pairs of limbs/6 legs,*
- *a pair of antennae, and*
- *three thoracic segments (prothorax ,mesothorax and metathorax)*

b) From your observation of the external features, state with reasons the sex of the specimen. **(2mks)**

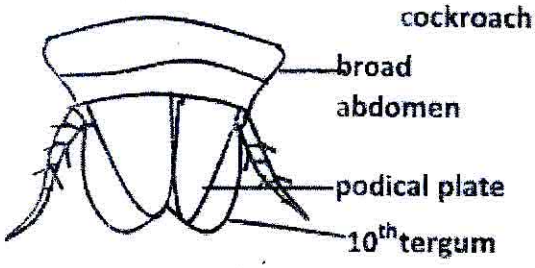
Male	*Female*
1. Has a narrow abdomen	*Has a broader abdomen.*
2. Has a pair of long anal styles	*Has podical plates for holding the ootheca/egg case.*
3. Has pointed male gonapophysis	*has blunt female gonapophysis*

c) Place the specimen ventral side upper most .Draw and label the end of the abdomen. (5mks)

ventral posterior end of a male cockroach

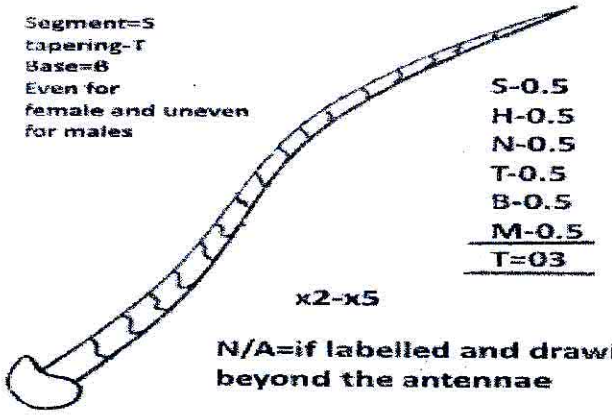


ventral posterior end of a female cockroach



d) Using a hand lens examine one antenna and draw .do not label. **(02mks)**

Drawing showing one antenna of specimen K



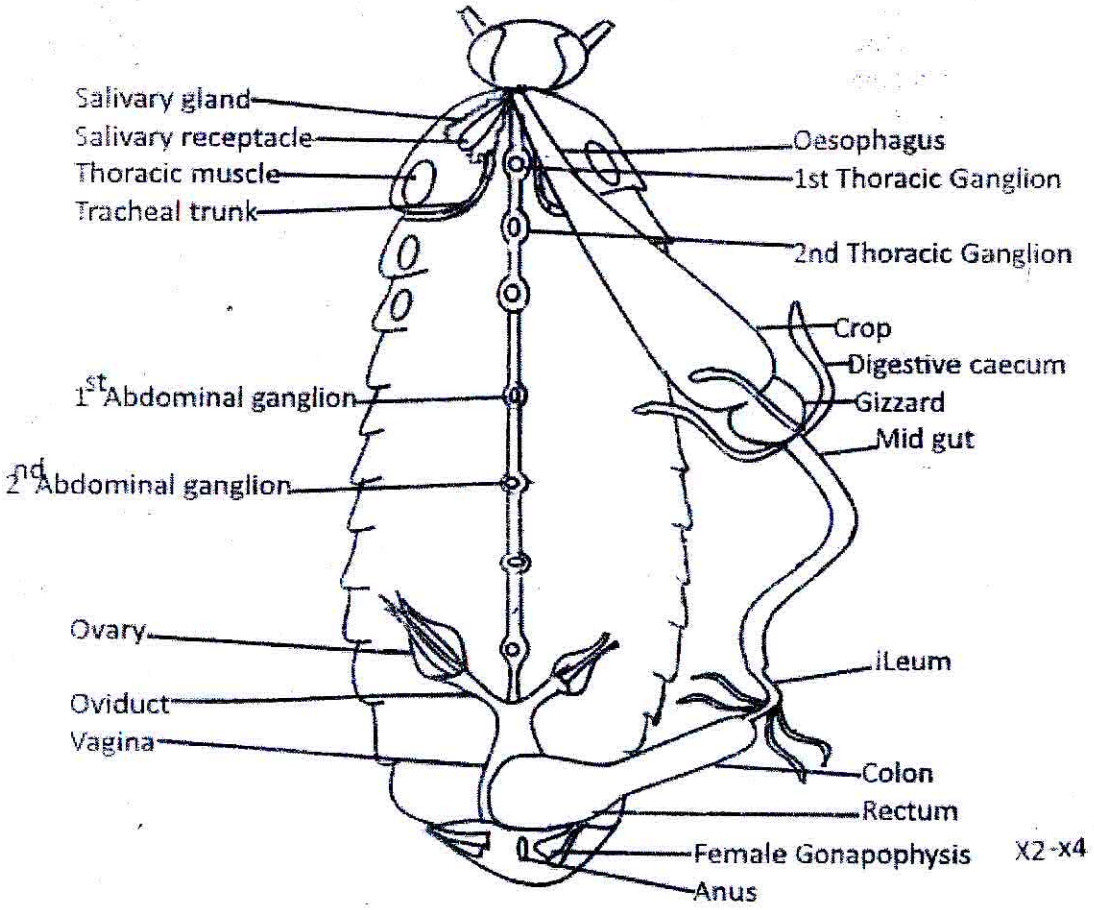
e) Place the specimen dorsal side uppermost and dissect to expose the structures within the abdominal and thoracic cavity.

i) Displace the structures to display the salivary glands on the left of specimen.

ii) Displace the alimentary canal to the right of the specimen. Remove all unnecessary tissue to display all the parts of the alimentary canal and the structures on the ventral cuticle.

Draw and label. **(24mks)**

Drawing of specimen K showing alimentary canal displaced to the right,salivary glands displaced to the left and structures on the ventral cuticle.



Question 2

You are provided with specimen **B (large Irish potato)**

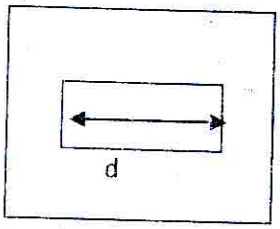
(a) Using a scalpel, peel the specimen then cut **two** cubes from it. Cube B_1 measuring, 10mm and cube measuring B_2 20mm.

(i) Calculate the surface area, the volume and the surface area to volume ratio of each tube in table 1. Show your working clearly in the table below. (3mks)

Table I

cube	Volume 0f cube/mm^3	Surface area/mm^2	Surface:volume ratio
B_1	*Vol= L x w x h* *=10x10x10* *=1000 mm^3*	*S.A=2(lxw)+2(lxh)+2(wxh)* *=2(10x10)+2(10x10)+ 2(10x10)* *=600mm^2*	***6:1***
B_2	*Vol= L x w x h* *=20x20x20* *=8000 mm^3*	*S.A=2(lxw)+2(lxh)+2(wxh)* *=2(20x20)+2(20x20)+ 2(20x20)* *=2400mm^2*	*24:8* ***3:1***

ii) Immerse each cube completely in a beaker containing concentrated iodine solution and leave for 50 minutes. After 50 minutes remove the cubes from the solution and wipe them using a blotting paper. Using a razor blade, cut each cube into two halves. Using one half of each cube, measure the distance in mm, across the uncoloured portion as indicated in fig .1



Record your results
B_1 = **5 – 9 mm**
B_2 = **16 – 19 mm**

(iii) What physiological process in observed in (i) (01mks)

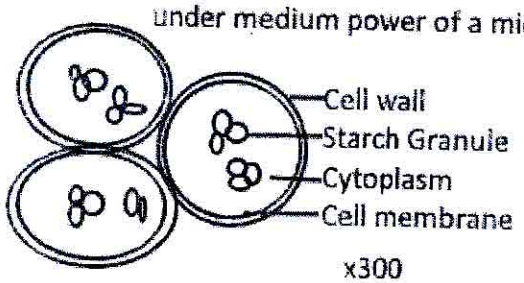
DIFFUSION

(iv) How do the results in (ii) relate to the physiological process named in (iii), in living organisms?

The smaller the organism; the large the surface area to volume ratio; the faster /grater the rate of diffusion. The bigger/larger the organism the smaller the surface area to volume ratio; the lower /slower/the rate of diffusion

(d) Cut a very thin slice of specimen **B** using a sharp razor blade. Place the slice on a slide in a drop of water irrigate with iodine solution. Observe the slice under the medium power of a microscope.
(i) Draw and label the three adjacent cells observed **(06mks)**

Drawing showig three adjacent cells of specimen B observed under medium power of a microscope



x300

D-02	
L-02	
M-0.5	
T-0.5	
N/C-0.5	
T=5.5	

(ii) Giving a reason, suggest the name of the tissue observed (02mks)

Its parenchyma tissue; due thin walled; compact cells; presence of starch granules/grains
(iii) From your observation, state the function of the tissue observed (02mks)

For storage of starch.
(d) Using a mortar and pestle, crush the remaining piece of **specimen B**. add $10cm^3$ of water to it, stir then decant the liquid part into a test tube.

(i) Carry out tests for proteins, starch and reducing sugar on the solution, using the reagent provided. Record your tests, observations and conclusions in Table II.

Table II (10mks)

Test	**Observation**	**Conclusion**
Protein test To **1cm^3**; of food Solution add **1cm^3; of NaOH solution** ;followed by **2/3 drops** ;of **$CuSO_4$** solution; Or To 1cm^3 of solution B was added 1cm^3; of millon's reagent; and the boiled;	*Turbid suspension; turns to Pale purple solution ;* *Pink/red coagulation/mass*	*Little; proteins present;*
Starch test To 1cm^3; of food substance was added 2/3 drops ;of iodine solution;	*Black/blue-black solution* ***Rej purple***	*Much ;starch present ;*
Reducing sugar test To 1cm^3 ;of food substance was added 1cm^3 ;of Benedict's Solution; and boil ;for 2 min	*Turbid suspension; turned to Green solution/yellow ppt* ***Rej beyond yellow***	*Little/moderate reducing sugars present*

(ii) To 5cm^3 of solution **B**, add 2cm^3 of solution **Y (amylase)** provided. Incubate in a water bath at 35-40^{O}Cfor 10 minutes. Repeat the tests in Table II above using the incubated mixture.
Record your observations and conclusions in Table below. (6mks)

Test for;	Observations	Conclusion
Proteins -Do-	*Turbid suspension; turns to purple solution ;* ***or*** *Pink/red coagulation/mass*	*proteins present;*
Starch -Do-	*Pale brown/yellow solution* ***Or*** *Pale blue/specks of blue-black* ***Rej blue alone***	*Starch absent* *Traces of starch present*
Reducing sugars -Do-	*Yellow/orange/brown ppt*	*moderate/Much reducing sugars present*

(iii) From the results in(c) (ii) suggest the nature of solution **Y.** (02mks)

Starch was hydrolyzing/digesting/breaking agent/enzyme/biological catalyst/carbohydrases.
Rej amylase/salivary amylase/diastase/active substance/acts on/work on

iv) State one property of solution **Y** by the results in(c) (ii)
It is specific in action ;since it catalysed the hydrolysis of starch only but did not catalyse the hydrolysis of proteins

Question 3
C=banana inflorescence; D=cassia; E=maize and F=bougainvillea

You are provided with specimen C(banana),D(cassia),E(maize)and F(bougainvillea) which are inflorescences.
a) Observe each specimen and describe the pattern of arrangement of florets.
C: banana
Arranged/clustered/crowded/grouped in two rows; attached at the base/one point of the spathe/bract/covered in spathe/on inner surface of spathe/bract. Attached directly/unstalked/sessile on the peduncle.

D: cassia
Alternately arranged/spirally; at different parts by a pedicel/flower stalk/stalked/pedicellate (pedicel of variable length
E: maize
Floretspaired; alternately arranged on peduncle; one with short stalk/pedicel/pedicellate/stalked; another sessile/unstalked; enclosed in bracts/spikelets
F: bougainvillea
Attached on the inner upper surface of bract; each floret on its bract a long midrib/main vein and in threes onto the peduncle/at on stalk/pedicel fused with midrib

b).Remove a single floret from **specimens C,D and ,E.**
Examine the florets using a hand lens where necessary.
i).Give two descriptive features on each of the following floral parts of each floret.

Floral part	Floret of specimen C/banana	Floret of specimen D/cassia	Floret of specimen E/maize
Pistil	*The **pistil** is **syncarpous,** consists of inferior, elongated and tapering **ovary** towards the base, elongated, grooved **style** with trilobed **stigma** (3 fused stigmatic surface) and brightly coloured.*	*it is monocarpous Pistil; with elongated; dull coloured; curved; and superior **ovary**; short style and flattened stigma surface.*	*Absent/none*
Anthers	*Flattened;elongated;grooved, bilobed, brightly coloured and curved (shovel) anthers.*	*Bilobed, elongated, thick and curved anthers with variable sizes.*	*Large; grooved; elongated bilobed; dull coloured anthers.*
Petals	Absent/none	*Curved; free (polypetalous), brightly coloured, large, prominently veined and papery (thin) petals.*	Absent/none

Bracts	*Dull coloured prominently parallel veined; large; thick /fleshy/spongy and in ward curved/boat shaped/shovel.*	Absent/none	***outer bracts/glume** are thick;hairy;hard;tough and curved/boat shaped, inner bracts/**Palea** are membranous/thin; smooth; curved in wards and occur in pairs .both inner and outer bracts are parallel veined and dark coloured.*

ii) With reference to the information in the table in b(i),state how the florets from specimens D and E are adapted to their modes of pollination. **(2mks)**

Floret from **D/cassia**

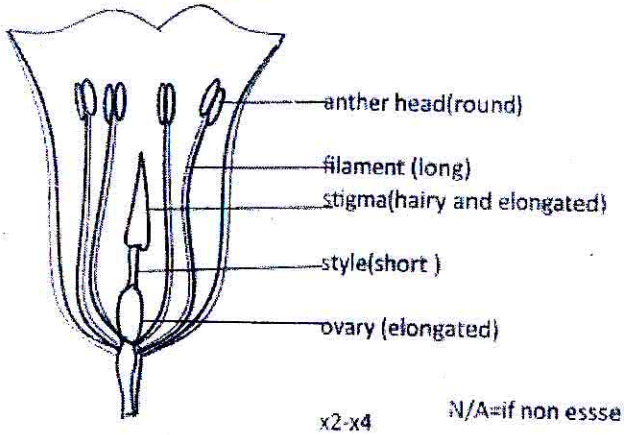
Thick conspicuous/brightly coloured petals to attract pollinators/insects

Florets from **E maize**

- *Large and Elongated anthers for carrying large quantities of pollen grains that make pollination easy*
- *The loose attachment of anthers to the filament makes pollination easy.*
- *The long nature of filaments exposes the anthers hence making pollination easy.*

c).Remove one floret from specimen **F.** Cut it symmetrically into two halves .observe the internal structures using a hand lens.
Draw one half of the floret and label only the essential reproductive floral structures.

Drawing of longitudinal section of specimen F showing essential reproductive structure
floral structures



x2-x4

N/A=if non esssential parts drawn and labelled

UACE BIOLGY PAPER 3 2003

Question 1

You are provided with a fleshy killed specimen labeled ***R (rat).***

a) Study the external features of the specimen and list three observable features that enable the specimen to colonize land.

(03mks)

- *Its funnel shape eases trapping of sound waves for easy hearing and to increase its sensitivity to sound.*
- *Eyes are dorsal-laterally located midway on the head for wide vision/to increase the field of view.*
- *Narrow opening for easy smelling and breathing thus are sensitive smell.*
- *Whiskers/vibrissae/ long hairs brittle in nature makes it easy to detect the diameter of the burrow.*
- *Mouth ventrally located for easy ingestion of food materials.*
- *Tail is long and tapers anteriorly, solid /hard, long and flexible for defense by whipping /lashing the enemy.*
- *Fur to reduce water loss/conserve heat.*
- *Pointed claws for firm grip/support/easy holding of food/digging tunnels/burrows/escape predation*
- *The protruding incisors which are sharp top/ chisel shaped, long hard and curved in wards for easy cutting of food and for defense by biting the enemy.*

b) i) measure the length of the tail and that of the tail plus the rest of the body.
Express your results as ratio of;

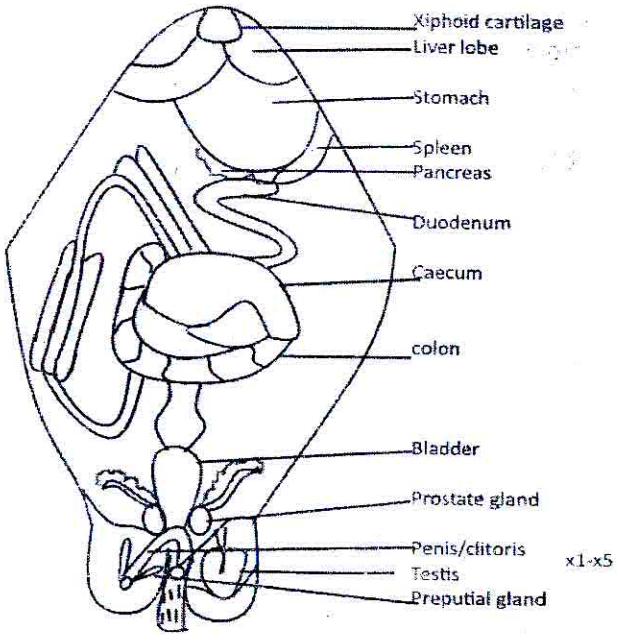
Tail: rest of the **body** **1 : 2** (1mk)

ii) Suggest the significance of the ratio in the life of the animal. (2mks)

Tail being half the length of the whole body helps to give support/balance/maintain raised head/drive away other organisms/predators/defence

c i) dissect the specimen to clearly display the structures lying posteriorly to the diaphragm without displacing organs .draw and label your dissection. (20mks)

Drawing of specimen R showing structures lying posterior to the diaphragm without displacing any organs

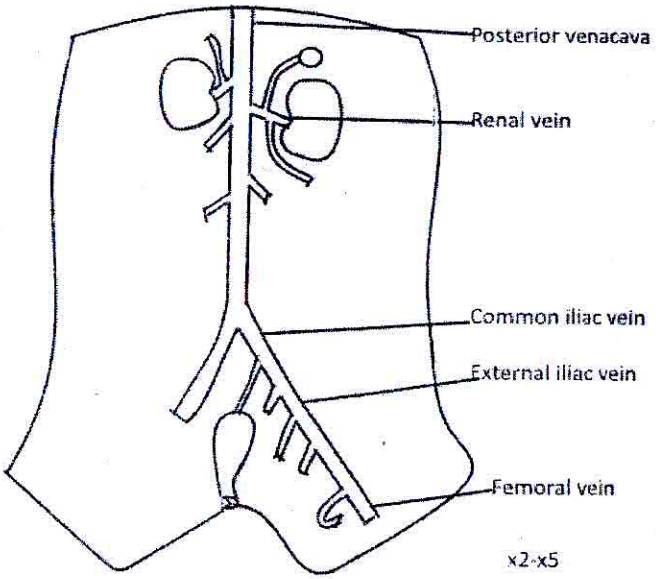


DL-16
M-01
T-01
N-01
O-01
U/D-01
T-21

x1-x5

ii) Dissect the specimen further to display the blood vessels that drain blood from the thigh of the left hind and kidney back to the heart .draw and label. (12mks)

Drawing showing blood vessels that drain blood from the thigh of the left hind and kidney back to the heart of specimen R



x2-x5

N/A if right side drawn/ for artery

Question 2

You are provided with solution Z **(Irish potato)** which is a plant extract and solution **V (10 volume H_2O_2)**. label six test tubes **A, B, C, E** and **F** and put into each test tube 3cm^3 of solution V.

(a)(i) To test tube **A** add 1cm3 of solution **Z** at once. Record the observations and the time taken for the reaction to stop.

(ii) Repeat the procedure in (a)(i) with test tubes **B,C and D in** water bath of temperatures 30^{o}c, 40^{o}C and 50^{o}C respectively and enter all the results in Table 1. ***03mks @***

Test tube	Temp (^{o}C)	Observations	Time taken for the reaction to stop(sec)
A	**Room temperature**	*Few/Little/Bubbles/Effervescence/Foaming/Fizzing*	*Longest time 1000 sec*
B	**30**	*Moderate/many effervescence*	*Moderate time 500-100 sec*
C	**40**	*Very many /much/rapid effervescence*	*Shortest time 60-500sec*
D	**50**	*No reaction/ no effervescence/ no bubbling*	*Zero second*

(b) Solutions W and X are common laboratory reagents.

Add 5 drops of solution W into test tube E and 5 drops of solution X into tube F, and then add 1cm3 of solution Z to each of the test tubes E and F simultaneously. Record your observation in Table 2 below.

Test tube	**Contents**	***Observations***
E	**V(1% H_2O_2)+W(NaOH)+Z(extract)**	*Much/rapid/a lot of effervescence*
F	V+X(**HCl**)+Z	*Few or no effervescence/a little effervescence*

(c) The concentrations of solution V have varied to give solutions V_1, V_2 and V_3

Contents of test tube	Observations
V_1 **(0.5% H_2O_2)**+Z	Few/slow/effervescence/bubbling/forming/fizzing
V_2**(1% H_2O_2)** +Z	Many/moderate/effervescence
V_3 **(2% H_2O_2)**+Z	Very many/rapid/effervescence

(d) Explain the observation you have made in test tubes

(i) A, B, C and D in (a):

Test tube A (Room temperature)

There is low break down/decomposition of H_2O_2/low activation of enzyme ;due to low temperature

Test tube B

There is moderate break down of (H_2O_2) due to increased temperature to moderate/relatively higher than room temperature

Test tube C

Fast reaction/high activation/mobility of active substance due to optimum temperature

Test tube D

No activity of active substances due to denaturing of the enzyme by O_2 high temperatures.

(ii) E and F in (b)

Test tube E:
*W is a suitable/favourable medium for the reaction **between V and Z**/breaking down/ decomposition of V by Z*
Test tube F:
*X unfavourable/ unsuitable medium for the reaction between **V and Z.***

(e) In part (c) where the concentration of V has been varied, arrange the solutions in order of increasing reactivity, starting with the least reactive.

V_1;V_2 and V_3 (must get the whole order correct).(It must comply with C table behind)

(f) Giving two reasons, suggest the active substance in solution Z. **(03mks)**

Active substances is likely enzyme/organic catalyst/catalase

- *Inactivated at low temperature/room temperature*
- *Most active at optimum temperature/40^0C*
- *Denatured at higher temperature/50^0C*

Reject: PH since experiment on PH gives no observation due to the identity of the active substances.

(g) What properties of the active substance have been demonstrated? **(03mks)**
Active Substances is:

- *sensitive to lab reagents*
- *inactivated at low temperature/room temperature*
- *Most active at optimum temperature*
- *Denatured at high temperatures/50^0C*
- *catalyses the breakdown of Z/decomposes Z*
- *its activity varies with concentration of substrate*

Question 3 **(49 minutes)**
You are provided with specimens'(unripe mango),Q(green bean pod),R(unripe Orange),S(cucumber),T(green pepper) and U(unripe pawpaw).
Open specimen Q longitudinally and cut the rest transversally.
a) Looking at the sections; *describe seed arrangement in* each of the following specimens.**(02marks each)**

i) P (mango),

One enlarged seed; at the centre/middle/within a single chamber/locule attached by the funicle at the base;
***For avocado** the seed is attached at the apex by a funicle*

ii) Q (bean pod),
Many enlarged seeds attached along the side /margin/peripheral/on one side of the pericarp;;

iii) R (Orange),
Many seeds radiating outward; from central point/placenta/in a circular pattern;
Seeds embedded in juicy/succulent endocarp;

iv) S (cucumber),

Many seeds suspending/radiating/pointing inwards; at 3/4 points/sites; in a regular manner

v) T (green pepper)

Many seeds clustered /crowded/many concentrated; on the central placenta/at the placenta.

b i).Give two internal features common to both **specimens T and U.** **(2mks)**

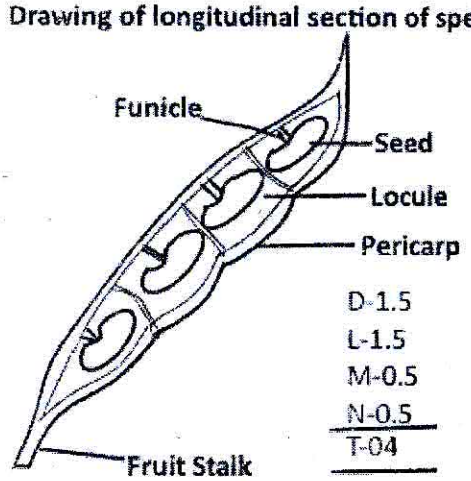
- *Both have placenta*
- *Possession of seeds/many seeds*
- *Mesocarp fleshy/succulent;* ***rej edible/colour***
- Both Divided pericarp or mesocarp and endocarp is divided
- Large/open locule/chamber/hollow inside

ii) State one difference in the internal structure of specimens T and U

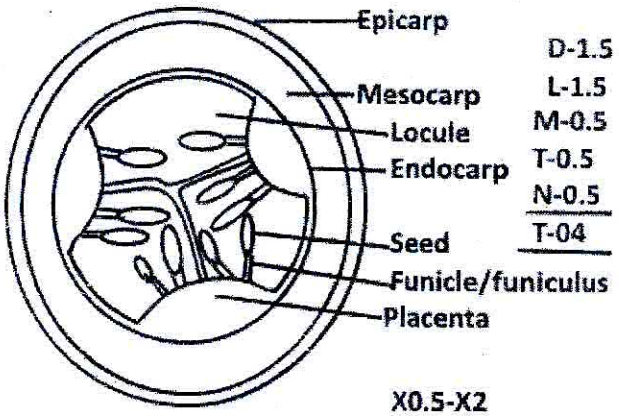
specimens T	*specimens U*
• *Placenta at the centre /arises at the base*	• *Placenta at the peripheral/sides*
• *Posses septa/divided locule*	• *No septum/undivided locule*
• *Thin mesocarp*	• *Thick mesocarp*
Re: type of placentation	

c) Draw and label a transverse section of **specimen S** and one half of **specimen Q** which is containing the seeds.

Drawing of longitudinal section of specimenQ



Drawing of cross section of specimen S



d).Limiting yourself to the internal features of the specimen ,construct a dichotomous key to identify them. **(10mks)**

NB: use the following characterisics to consrtruct a dicotomous key

P(mango/Avocado)	*One seed; enlarged seed; divided pericarp or mesocarp and endocarp stony endocarp; fleshy/succulent mesocarp; thick mesocarp; seed at the centre; placenta at the base; single locule; long funicle*
Q(Bean pod)	*More than one seed; enlarged seed; fused endocarp and mesocarp; papery placenta; placenta along theone margin of the pericarp; single locule; short funicle*
R (orange)	*Many seeds; divided pericarp/mesocarp and endocarp; placenta at the centre; thick endocarp; juicy endocarp; stony seeds ;seeds radially arranged*
S(cucumber)	*Many seeds; divided pericarp or mesocarp and endocarp) placenta at the periphery/outer side; fleshy/succulent mesocarp and endocarp; placenta at ¾ points; seeds arranged in regular manner; locule divided/three locules/chambers ;has septa;prominent long funicle*
T(green pepper)	*Many seeds; divided pericarp; placenta central; placenta arises from the base; locule divided/has septa;seeds clustered on the placenta*
U (paw paw)	*Many seeds; divided pericarp; or mesocarp and endocarp; placenta peripheral/outer side; fleshy /succulent mesocarp; papery/thin endocarp; rough seeds*

UACE BIOLGY PAPER 3 1998

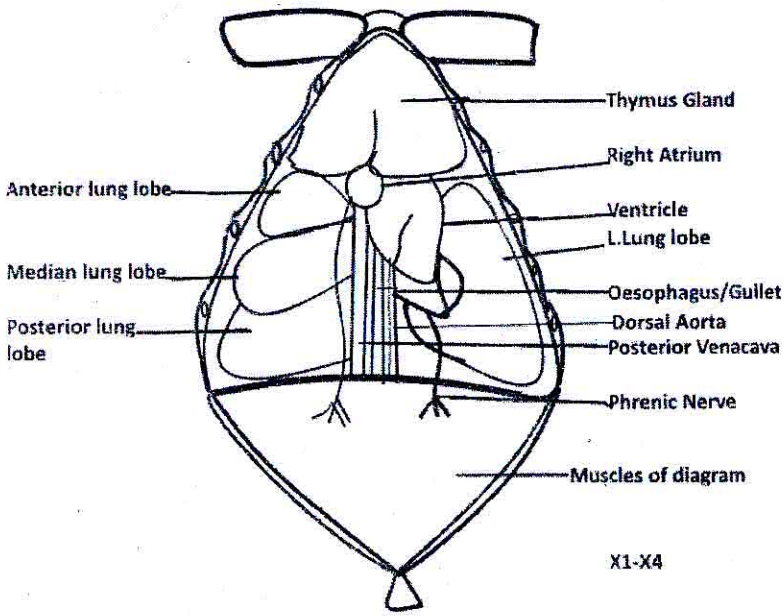
Question 1

You are provided with specimen T **(rat).**carry out the dissection of the specimen the following procedure.

Pin the animal with ventral side uppermost .remove the skin of the thoracic region including the neck .lift the xiphoid cartilage and cut along the lower edge of the rib cage. The tie the xiphoid cartilage .pull it back and pin it down .cut along the sidewall of the thorax on both sides to remove the rib cage.

i) Draw the thoracic region without displaying any organ and label fully. (22mks)

Drawing of the structures in the thoracic region in undisturbed state/ situ of specimen T



ii) Locate the trachea and examine it. Describe its structure. (04marks)

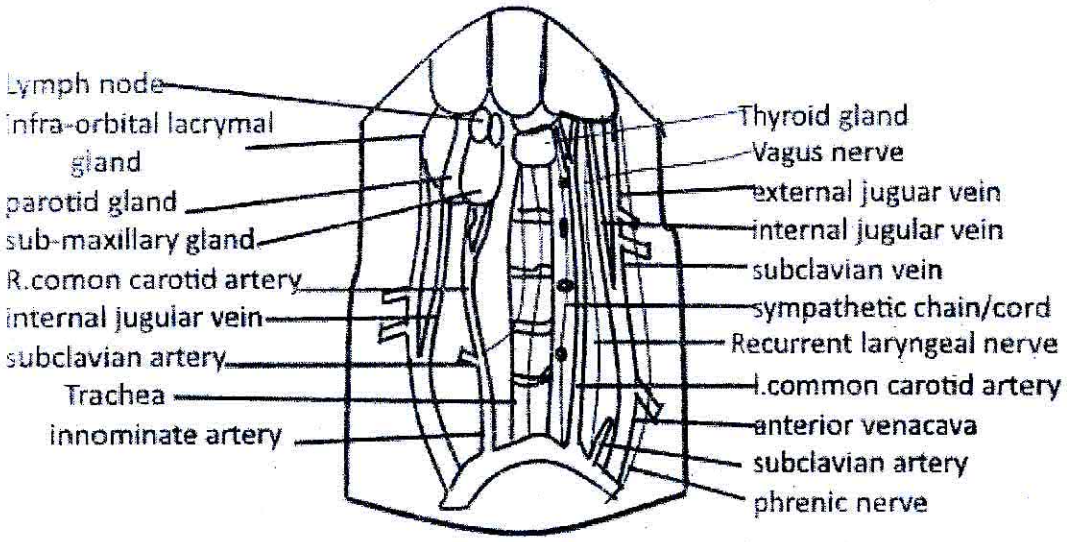
Cartilagenous; rigid; ringed; open/hollow/tube like; cylindrical;

c) How is the structure of the trachea related to its function?

- *Rigid to keep the trachea open or support*
- *Cartilaginous for flexibility;*
- *Ringed to keep it open/hollow and flexible*
- *Hollow/tube like to allow air passage;*

b) Now dissect the specimen further into the neck to display the glands, organs and their accessory structure that can be seen from the ventral side of the neck region, anterior to the forelimb.
i) Make an accurate, well labeled drawing of the dissection. (**22** marks)

Drawing showing structures in the neck region and accessory structures of specimen



X2-X5

ii) Briefly state the function of each of the structures you have labeled in(b)(i) above.

- **sub-maxillary gland – scretion of saliva**
- **Infra-orbital larymal gland-production of tears**

Question 2

You are provided with food extract **E** and you are also required to make two other extracts **X** and **Y** from the dissection of question one as follows;

i) Obtain a whole stomach from the dissection .cut it open and wash out the contents.
ii) Chop the stomach into small pieces and grind it into a paste and add 10cm^3 of distilled water to obtain an extract.
iii) Allow to stand for 5 minutes and pour off the liquid in a test tube and label it **X**
iv) obtain a whole pancreas and follow steps (II) and (iii) to obtain an extract and label it **Y**

label 6 test tubes **1-6.**put 1 cm^3 of the food substances **E** in each test tube .add 1 cm^3 of X into each of the tubes ***1 , 2 and 3*** and 1cm^3 of Y into each of the tubes ***4,5 and 6***.to each of the test tubes ***1 and 4*** add 1 cm3 of distilled water to each of the tubes ***2 and 5*** add 1 cm^3 of dilute Hydrochloric acid, to each of the

tubes ***3 and 6*** add 1 cm^3 of dilute sodium hydroxide. A summary of the contents of each tube is indicated in the table below. Place all the test tubes in a water bath at a temperature ***(35-40^{0}C)*** and leave for ***20*** minutes shaking periodically. Observe and record your results in the table below.

Test tube	TESTS	OBSERVATION	CONCLUSION
Test tube 1	Put 2 cm^3 of **E** in a test tube +1 cm^3 of solution **X** + 1 cm^3 of **water**	*Remains turbid/cloudy*	*No hydrolysis / breakdown of **E***
Test tube 2	Put 2 cm^3 of **E** in a test tube +1 cm^3 of solution **X** + 1 cm^3 of dil hydrochloric acid	*Remains turbid/cloudy*	*No hydrolysis / breakdown of **E***
Test tube 3	Put 2 cm^3 of **E** in a test tube +1 cm^3 of solution **X** + 1 cm^3 of dil sodium hydroxide	*Remains turbid/cloudy*	*No hydrolysis/breakdown of **E***
Test tube 4	Put 2 cm^3 of **E** in a test tube +1 cm^3 of solution **Y** + 1 cm^3 of ***water***	*Turbid Solution clears/partially clears;*	*Hydrolysis/breakdown of **E** **occurs***
Test tube 5	Put 2 cm^3 of **E** in a test tube +1 cm^3 of solution **Y** + 1 cm^3 of dil hydrochloric acid	*Remains turbid/cloudy*	*No digestion/ No hydrolysis/breakdown of **E***
Test tube 6	Put 2 cm^3 of **E** in a test tube +1 cm^3 of solution **Y** + 1 cm^3 of dil sodium hydroxide	*Turbid solution clears /turns to colourless*	*Digestion /Hydrolysis/breakdown of **E** **occurs***

c) From your results; describe the nature of substance **E**

- *solution **E** cannot be digested under conditions in the stomach; and in acidic medium; but it can be digested under conditions of the pancreas in neutral medium; alkaline medium*

c) What do the above results tell you about the behavior of extracts **X and Y**?

- *Extract **X** does not catalyse the hydrolysis of food substance in **E**;under any PH medium;*
- *Extract **Y catalysed the** hydrolysis of food substance in **E**; under neutral medium and alkaline medium; but not in acidic medium*

Question 3

You are provided with specimen **K (maize inflorescence) ; L(crotolaria) M(bougainvillea) ;N(commelina) O (banana) and P(bidens pilosa)** which are flower..

a) Using a hand lens, carefully examine specimen **L** and one flower of specimen **K** and state three observable differences between them

K-maize	**L- crotolaria**
• Dull coloured	• Brightly coloured
• Has bracts	• Lacks bracts/has petals/sepals
• Unisexual/staminate/has only stamens	• Bisexual /has both stamens and pistil
• Anthers hanging outside bracts	• Anthers within petals

b) State one functional difference between specimens **K and L** **(02marks)**

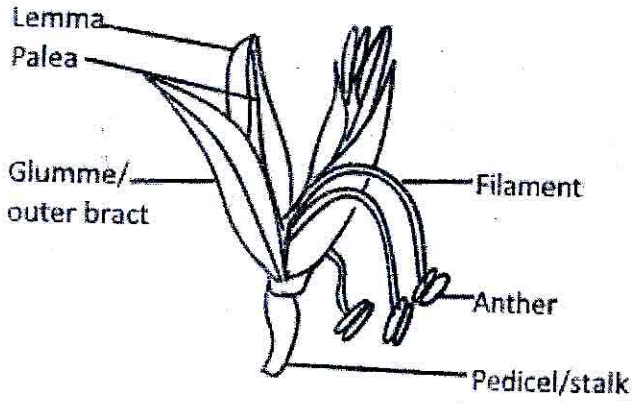
K produces only male gametes/pollen grain while L can produce both male and female gametes

c) Give one functional advantage which **specimen L** has over specimen **K** **(02 marks)**

Production of seeds/fruits can occur within while K requires presence of a female flower in order to produce seeds
Acc-brightly coloured/sticky stigma

d) Using a hand lens; examine one flower of specimen K carefully.make a large well labeled drawing of the specimen

DRAWING OF ONE FLOWER OF SPECIMEN K



D-03
L-03
M-0.5
T-0.5
N-0.5
T=7.5

X2

d) Using specimen **K-P** 'construct a dichotomus key to identify the specimens

Specimen	Features
K-Maize flower	Dull coloured ;bisexual/staminate; anthers hanging outside the bracts; inflorescence/raceme/flowers are borne in pairs/spikelets; pendulous stamens;zygomorphic;
L-Crotolaria	Bisexual ;irregular/zygomorphic; five calyx ;not of same size/two big/large ones; corolla-five petals; two fused keel petals/3 free ones ;veined smooth and thin petals Androecium –ten stamen ;9 fused and one free; stamen part of the filaments fused (9 fused) to form a stamen tube.long filament for the single stamen and short filaments for the 9 stamens. Two types of anther/7 elongated rounded and shorten Monocarpous pistil; very short style and hairy in crotolaria
M -bougainvillea	It consists of three asessile, bisexual, and zygomorphic florets all attached at the end of the peduncle. Each floret is attached on inner upper surface along the midrib of the bract. The pedicel of the floret is fused with the midrib of the bract which is bright coloured, large and veined. Each floret has perianth which is dull coloured and fused into funnel tube. Each floret has a pistil with a superior, elongated ovary and short, flexible style, and spear shaped, elongated, hairy stigma. Florets have eight, long, thin and slender filaments with rounded bilobed anther heads.
N-commelina	An inflorescence It has one or few florets on the peduncle which are a sessile (stalked). Each floret has a single, curved, hairy, dull coloured and parallel veined spathe (petal like bract). Each Floret is stalked; bisexual; irregular /zygomorphic.; have three,broad;veined,thin smooth;curved free brightly coloured petals and calyx three;tapering veined;thin and hairy; Each Florets has syncarpous with stigma trilobed ;hairy attached on relatively long stylethin and slende and brightly coloured ;superior ovary and free stamen consisting of brightly coloured;bilobed;elongated anthers that are supported by long, thin;hairy middle way and flexible filament.
P- bidens pilosa	An inflorescence It has numerous sessile florets which are attached onto a flattened (cup shaped) and expanded apex of the peduncle surrounded by a calyx - like involucres of bracts. Two types of floret occur, both sessile with fused corolla, free and spiny calyx and an inferior ovary with one ovule attached at the base of the fruit. The **numerous, sessile inner florets called the disc** or tubular florets are arranged in the circular pattern around the centre and closely packed. The disc or tubular floret are bisexual, Actinomorphic and consists of five fused petals which form a tube hence the name tubular floret. Its petals have many corolla projections. It has five stamens with fused, bilobed, and elongated anthers and short filaments, Pistil has long forked stigma. The ray/outer florets are called **ligulate floret in** which the corolla tube is extended and has no stamens and pistil (is sterile.) and are covered by numerous overlapping and dull coloured bracts making the involucres. 'The ray (ligulate) florets are zygomorphic and found at the peripheral of the expanded apex of peduncle. It consists of broad/open petals at the apex which are tubular at the base.

Construct the dichotomous

1a) specimen with bracts.....K
b)specimen that lacks bracts.....go to 2
2a)specimen with stamens fused with stamen tube.....L
b)specimen with stamens free/not fused.....go to 3
3a)specimen corolla and calyx distinguishable.....M
b)specimen with corolla and calyx indistinguishable.....go to 4
4a)specimen with stigma trilobed.....N
b)specimen with stigma bilobed/forked.....P

RESOURCEFULL MOCK 1

Question 1

You are provided with freshly killed specimen **E (toad).**

a) Examine the skin in the trunk region from the dorsal and ventral side

i) State three differences observed

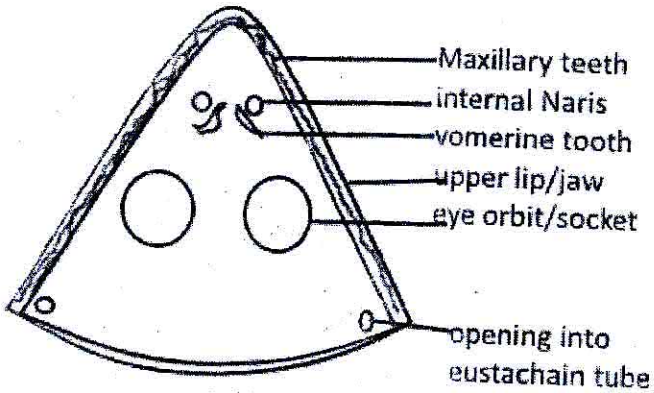
Dorsal side	Ventral side
1.rough surface	*Smooth surface*
2.dull coloured	*Pale coloured*
3.firmly attached	*Loosely attached*
4.many poison glands	*Lacks poison glands*
5.more moist due to many mucus secreting glands	*Less moist*

b) Suggest explanations for the observed differences in a)i) above. (03mks)

- *Rough due to presence of many poison glands; smooth due to lack of poison glands;*
- *Dull coloured since exposed on land for camouflage while pale colour to blends with water;*
- *Many poison glands for protection of exposed/upper surface while lower surface on the ground;*
- *Firmly attached for protection; loosely attached to allow expansion of the abdomen;*

C) Pin the specimen with its back on the board; dissect to clearly display the structures of the roof of the buccal cavity. Draw ad label. **(10 marks)**

Drawing of the structures on the roof of the buccal cavity of specimen E

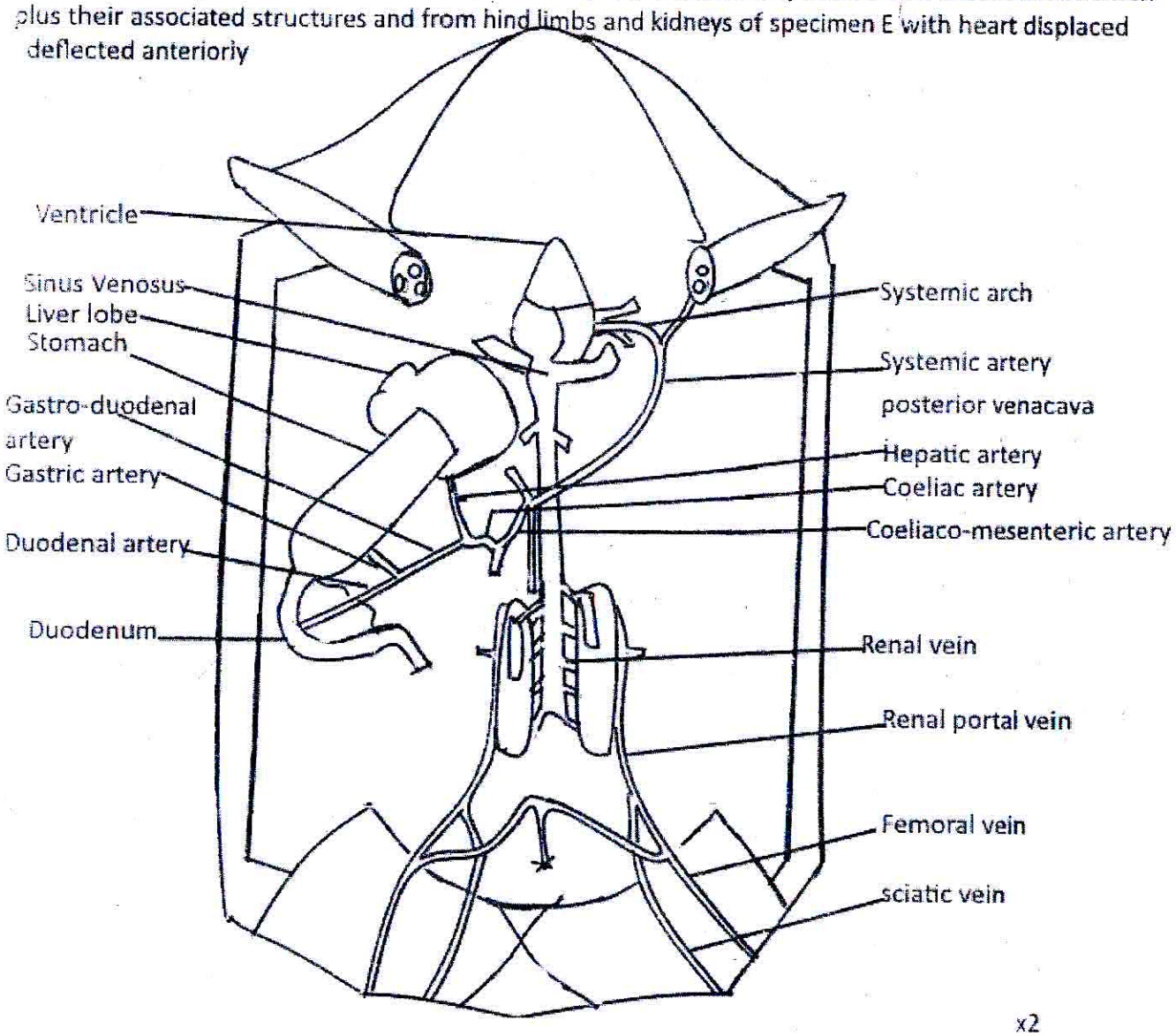


D-02
L-02
M-01
T-01
N-01
O-01
T=08

X1-X3

d) By further dissection, display the blood vessels that carry blood
i) To the parts of the alimentary canal located in the left of the abdomen plus the associated structures and from the hind limbs and kidneys back to the heart.
Draw and label with the heart deflected anteriorly **(24mks)**

Drawing showing blood vessels that carry blood to parts of alimentary canal in the leftof the abdomen plus their associated structures and from hind limbs and kidneys of specimen E with heart displaced deflected anteriorly



x2

Question 2

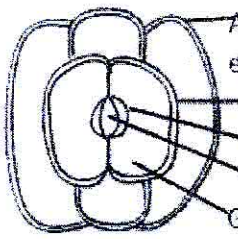
(C_1 (0.0M) and C_2 (1.0 M);D=large Irish potato C=2/3 commelina leaves; cork borer;10 &25 mls cylinder ; distilled water

You are provided with two sucrose solutions C_1 and C_2 of different concentrations and specimen **C**

a) Carefully remove three small strips of the lower epidermis from specimen **C** and place on to glass slides labeled C_1, C_2 and C_3 .Mount epidermal strips C_1 and C_2 in three drops of the respective solutions and strip C_3 in three drops of distilled water. Leave to stand for 10 minutes before observing under a microscope.

i) Draw part of the strip from C_3 to show one stoma and label. **(07 marks)**

Drawing showing six cells from C3 to include a stroma



DL-o5
M-0.5
T-0.5
N-0.5
N.C-0.5
T-07

ii) Record your observations and deductions for C_1 and C_2 in table 1 below:-

Strip	Observations	Conclusion
S_1	*Stomata open/thick inner walls of guard cells move apart*	*Solution S_1 hypotonic to the cell sap in guard cells*
S_2	*Stomata closed/thick inner walls of guard cells in contact*	*Solution S_2 hypertonic to the cell sap in guard cells*

iii) Explain how you have arrived at the conclusions above. **(02 marks)**

C1 similar to C_3 which was distilled water; while C2 the opposite effect/meaning guard cells gained water by osmosis and become flaccid causing thick inner walls to get in contact and close stoma.

iv) Compare the appearance of the stoma from C_1 and C_2 with that from C_3 as drawn above. (02 mark)

C_1 =stoma open like in C_3

C_2 stoma closed while that in C 3 is open

v) Explain your answer for C_1 in (a) (ii) above. **(04 marks)**

external solution hypotonic to the cell sap of guard cells/cells surrounding stoma; water moves into the cell sap; by osmosis; causing guard cells to become turgid ;the thick inner walls part ;opening the stoma

b) Prepare solutions 1-5 by mixing solutions C_1 **and** C_2 as follows;

i) Label **tubes 1-5** and add C_2 into the tubes as indicated in table 1.

ii) Make up the contents of each tube to $10cm^3$ by adding C_1. Record the volume of C_1 added into each tube in table 1 below. **(02½marks)**

TABLE: 1

TUBES	1	2	3	4	5
C_2/ cm^3	*10.0*	*7.5*	*5.0*	*3.0*	*0.5*
C_1/ cm^3	*0.0*	*2.5*	*5.0*	*7.0*	*9.5*

c) Carry out the procedures below:-

i) Cut five cylinders of length 6 cm from plant material **D** provided. Chop the first cylinder into ten smaller pieces of uniform size and transfer the pieces into solution -1

ii) Repeat the above procedure using the remaining cylinders and solutions **2, 3, 4** and **5**

iii) Leave the set up to stand for **1 hour.**

iv) After **1 hour**, pour all the solution from **test tube 1** into a small measuring cylinder and record the volume in **table 2**

v) Repeat the above procedure for solutions from the remaining tubes. Tabulate your results as follows:

TABLE 2 **(06 marks)**

solutions	**1**	**2**	**3**	**4**	**5**
Final volume(V_2) / cm^3	**10.6 >10**	**10.3>10**	**10.2>10**	**10.0⇨ 10**	**9.6 /<10**
Initial volume(V_1)/cm^3	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**
Change in volume (V_2-V_1) cm^3	**+0.5**	**+ 0.3**	**+0.2**	**0.0**	**-0.4**
Physical conditions of cylinder	**Very soft; flabby/flexibility /flexible; reduced size/shrunken; smooth texture**	**flabby/flexibility /flexible; reduced size/shrunken; smooth texture**	**Almost similar as before**	**Almost similar as before**	***Hard;rigid;swollen/increased in size 'rough texture***

d) Giving explanations based on the results in **table 2,**

i) Arrange solutions 1-5 in order of increasing osmotic potential **(01mark)**

Order **5,4,3,2, and 1**

Explanation (02½marks)

Solution 1 highest Volume of water added; meaning solution1 was the most hypertonic; ;followed by 2 ;3 ; 4;and solution 5; which lost water; meaning its most hypertonic

ii) Suggest the **solution(s)** with most predictable results

Solution (s) (01mark)

Solution 1 and 5

Explanation **(02marks)**

Solution 1 was most concentrated /had much C_2; therefore absorbs most water from cell sap of the potato cylinder; while solution 5 was most dilute and loses water to the cell sap of the potato cylinder

e) Explain the results in tube with solution **2** **(04 marks)**

solution 2 is hypertonic to the cell sap of potato tissue; therefore net movement of water molecules is into solution 2 ;by osmosis; causing the volume of the external solution to increase;

f) Explain two limitations of this experiment as a method of determining osmotic changes in plant tissues **(04 marks)**

- *initial concentration of solutions C_1 and C_2 may be incorrect; causing incorrect concentration of solutions prepared thus leading to inaccurate results;*
- *material P used may not be of suitable variety or poorly stored; and the cylinders obtained not osmotically active leading to inaccurate results;*

Question 3 (30 marks)

You are provided with specimens **P (millipede, Q (worker bee, R(blow fly/large house fly, S(large spider** and **T(soldier termite.**

Examine the specimens using a hand lens or low power magnification of a microscope and answer the following questions.

a) Give three structure differences and similarities between specimen **S** and **T. (06marks)**

Differences

specimen-s / spider	specimen-t/termite.
• 8 limbs	6 limbs
• has chelicerae • has two redipalps	has mandibles *has 2 antennae*
• lacks labial palps • 2 main body parts	has labial palps has 3 main body parts

i) **SIMILARITIES**

- **both have exoskeleton**
- **Segmented body**
- **Jointed limbs**

b) Describe three named parts observed in the head region of specimen **T** (03mks)

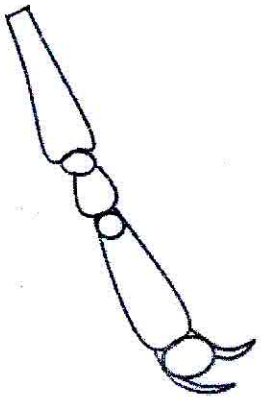
STRUCTURES	DESCRIPTIONS
1.mandibles;	*Long; curved; hard; dull coloured/black; tapering/sharp tip*
2.labial palps	*A pair of Short; thin; segmented; dull coloured/brown hairy (microscopic);*
3.antennae	*Short; segmented;;dull coloured/brown, hairy(microscopic)*

c) i) state four adaptive structural features for survival of specimen **P** in its habitat.(4mks)

- ***The antennae are hairy to increase sensitivity.***
- ***Serrated mandible for chewing the food***
- ***Many limbs for fast locomotion***
- ***Segmented body for flexibility***
- ***Large compound eyes for wide vision***

ii) Observe the last three segments at the end of the limbs of specimen T including the structures with the segments. Draw from inner view, but don't label. **(07marks)**

Drawing of the last three segments of specimen T plus structures associated with the segments



no. of segments
shape of segments
pulvini
glandular pad
view-V

D-05
M-0.5
T-0.5
N-0.5
View-01
T=07
x10-x40

d) Using only the structures responsible for locomotion in the specimens, construct a dichotomous key to identify the specimens in the order **P, Q, R, S** and ending with **T**
NB. (NO MARKS WILL BE AWARDE IF THE ORDER IS CHANGED) (06MKS)

1a) specimen with many limbs.....**P;**
1b) specimen with few limbs .....go to **2**
2a) specimen with wings .....go to **3**
2b) specimen without wings..... .....go to **4**
3a) specimen with four wings.....**Q;**
3a) specimen with two wings.....**R;**
4a) specimen with eight limbs.....**S;**
4a) specimen with six limbs.....**T;**

I=05 D=01 T=06

OR

1a) specimen with many limbs.....P
1b) specimen with few limbs .....**go to 2**
2a) specimen with hind limbs having pollen brush/basket.....Q
2b) specimen with hind limbs lacking pollen brush/pollen basket.....**go to 3**
3a) specimen with wings .....R
3a) specimen without wings..... .....**go to 4**
4a) specimen with eight limbs.....S
4a) specimen with six limbs.....T

RESOURCEFULL MOCK 2

Question 1 **80 minutes (42 marks)**

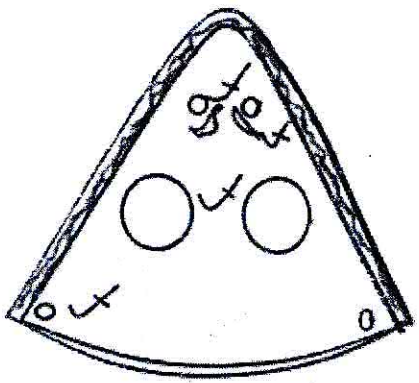
You are provided with a freshly killed animal labeled **T(toad)**
a) Examine the head of the animal provided. Describe the shape of the head and show how the shape relates to the mode of life of the animal.
i) Description of the shape. (02 marks)

Triangular; dorso-ventrally flattened; tapering; and joined to the trunk directly

ii) Relationship between shape of the head and the mode of life of the animal. (02 marks)
Tapering anteriorly gives the animal a streamline body; that reduces water/air résistance; during movement.
Dorso-ventrally flattened for increased surface area for floating;

b) Pin the specimen with its back lying on the board. Force the mouth open and insert one blade of the scissor along the right jaw .cut to expose the structures of the buccal cavity and pharynx.
Draw to show the structures on the roof of the buccal cavity. **Do not label** (04 marks)

Drawing of the structures on the roof of the buccal cavity of specimen T



D-02.5
M-0.5
T-0.5
N-0.5
T-04
X1-X3

c) Examine the hind and fore limb,
i) Give three differences in the structure of the hind and fore feet. (03 marks)

Fore foot	Hind foot
i) Free digits/No webs between the digits	*Have web between the digits*
ii) end in four well developed digits	*end in five well developed digits*
iii) shorter digits *iv) digits with fewer joints*	*Longer digits* *Digits with many joints*

ii) Suggest the significance of your observations in c (i) above for the hind foot to the life of the animal. (02 marks)

- ***Wedded digits; increased surface area for swimming;***
- ***Five digits; for support/stability;***
- ***Longer digits; for grasping/firm griping;***
- ***Many joints; for flexibility when grasping;***

d) Describe the attachment of the tongue and its outstanding features. (02 marks)

- ***Attached on the floor; at the front;***
- ***Tongue is long; elastic/stretchable; sticky/slimy and has many small blood vessels;***

ii) Suggest the significance of the way the skin is attached to the body wall as described in d (i) above. (02 marks)

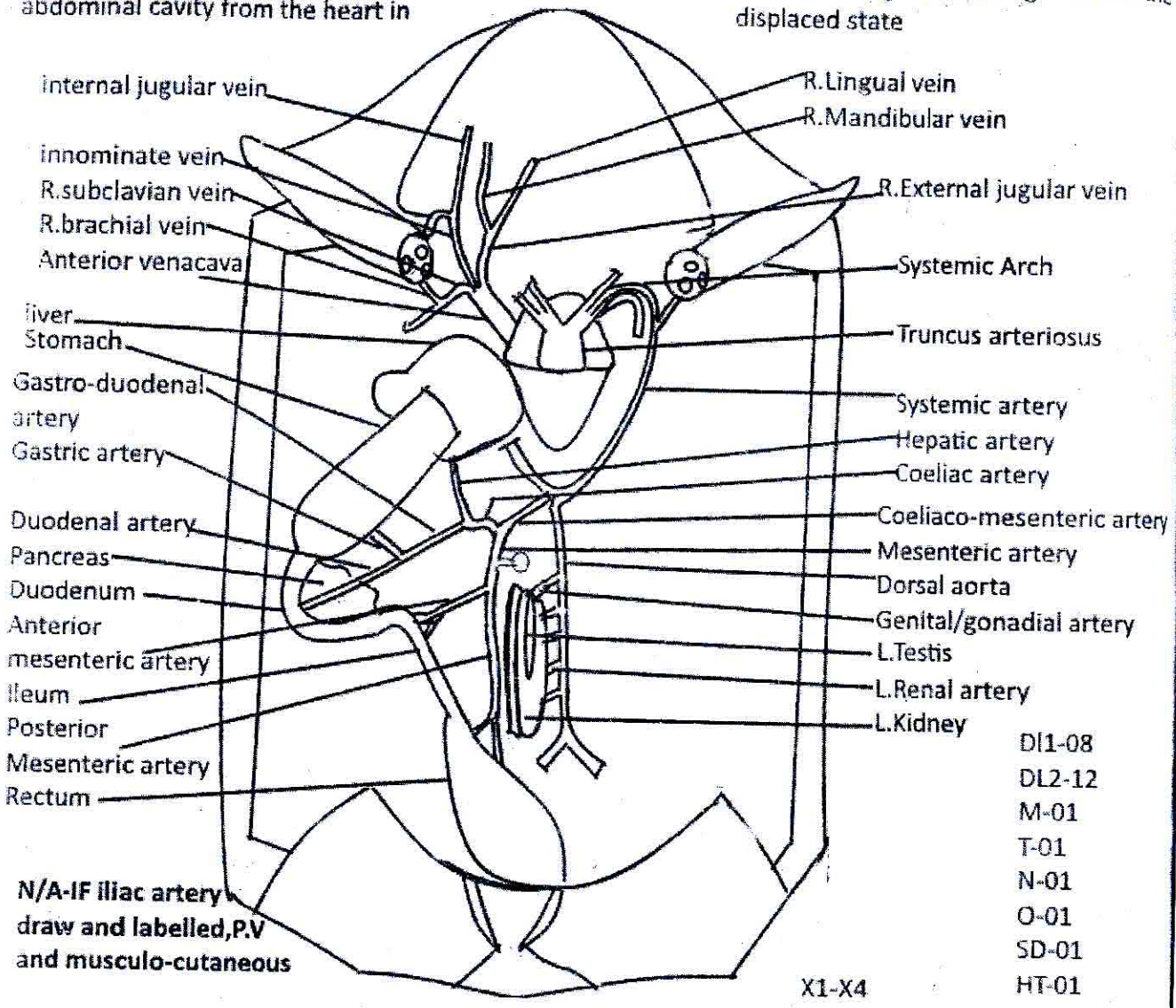
- ***At front of the floor to easily stretch;***
- ***Long to reach prey at long distance;***
- ***Elastic/stretchable to stretch and reach prey at a distance;***
- ***Sticky to trap prey;***

e i)Dissect the specimen further to display

i). The heart and blood vessels that drain blood from the right fore limb and head region.

ii). Blood vessels that transport blood to the digestive system and organs located on the right half of the abdomen cavity from the heart. With the heart in undisplaced state, draw and label the blood vessels and structures displayed in e (i) and (ii) above. (25 marks)

Drawing of specimen T showing the heart and blood vessels that drain blood from the right fore limb and the head reion and those that transport blood to the digestive system and organs in the right half of the abdominal cavity from the heart in displaced state



N/A-IF iliac artery draw and labelled,P.V and musculo-cutaneous

DI1-08
DL2-12
M-01
T-01
N-01
O-01
SD-01
HT-01

X1-X4

Question 2 **75 minutes (32 marks)**

Not R contains papian enzyme which digests proteins

You are provided with specimen **R(slice of pineapple)** which is a plant tissue and solution **P(1% trypsin), W (0.5M HCl), Z (0.05M $NaHCO_3$)** and a suspension **S(1 egg white in 1 litre).**
Squeeze a little juice from specimen **R** into a clean dry test tube and label it juice **R**.Also label four test tubes as A_1, A_2 ,A_3 and A_4. To each of the test tubes add 2 cm^3 of suspension S and note its appearance. Carry out the following procedures.

Test tube	procedure
A_1	Add 1 cm^3 of juice R and 5 drops of **W**
A_2	Add 1 cm^3 of juice **R** and 5 drops of **Z**
A_3	Add 1 cm^3 of boiled juice **R** and 5 drops of **W**
A_4	Add 1 cm^3 of juice **R** and 5 drops of distilled water.

Incubate the contents of test tubes 1-4 in a water bath maintained at 37-40^{0}C for **35** minutes.

a) After a period of incubation .make observations and deductions about the appearance of suspensions S in each of the test tubes in the table below.

(08 marks)

Test tube	**Observation**	**Deductions**
A_1	*Turbid suspension completely cleared/partially cleared/ turns to colourless*	*Complete breakdown of **S** occurred **OR** partial breakdown of suspension in **S***
A_2	*Turbid suspension remained turbid*	*No breakdown of suspension in **S***
A_3	*Turbid suspension remained turbid*	*No breakdown of suspension in **S***
A_4	*Turbid suspension partially cleared/**suspension remains turbid***	*Complete breakdown of in **S** occurred **OR** partial breakdown of suspension in **S***

ii) Explain the results in the table above for each of the test tubes. (10 marks)

A_1

Solution **W** provided a favourable medium for the active substance in juice; to catalyze the complete breakdown of food substance in **S** to form a clear solution/soluble solution;

A_2

Solution **Z** provided unfavourable medium for the active substance in juice **R**; that it did not catalyze the breakdown of suspension **S**.hence remained turbid

A_3

The active substance in juice **R** was denatured by boiling/excessive heating; though favourable medium was present; the active substance could not catalyze the breakdown of suspension **S; hence** solution remained turbid;

A_4

*Dilution inhibited action of the active substance in juice R; hence it did not catalyse; the breakdown of suspension **S;***

OR

*Juice **R** already had little amounts off favourable medium and the dilution did not inhibit the active substance to catalyze the breakdown of suspension **S** partially to form a partially hydrolyzed solution;*

b i) identify juice R (01 mark)

Contains enzyme/biological catalyst;

ii) State two properties of active substance in specimen R (02 marks)

- *Active substance in juice **R** favoured by solution **W** but inhibited by solution **Z** hence its medium specific;*
- *Active substance denatured by boiling hence inhibited by boiling;*
- *Its action is reduced by lowering its concentration;*

To each of the contents in the test tubes A_2 and A_3 , now add 1 cm^3 of solution P and incubate again under the same temperatures for **25 minutes.**

C i) after the period of incubation, make observations and conclusions about the appearance of the test tube contents in the table below. (04 marks)

Test tube	Observations	Deductions
A_2	*Turbid suspension completely cleared/partially cleared/ turns to colourless*	*Complete breakdown of **S** occurred **OR** partial breakdown of suspension **S***
A_3	*Turbid suspension remained turbid*	*No breakdown of suspension **S***

ii) Explain the results obtained in the table above for both test tubes. (04 marks)

A_2

Solution **Z** provided a favourable medium /suitable medium for the active substance in solution **P;** to catalyze the breakdown of suspension S to form a clear solution;/colorless solution;

A_3

Solution **W** inhibited the action of active substance; hence it didn't catalyze the breakdown of suspension **S;** therefore solution/suspension remained turbid;

d i) state the difference in the properties of juice **R** and solution **P** (02 marks)

*active substance in **R** is favoured by solution **W** but inhibited by solution **Z** while that in **P** its activity/action is promoted by solution **Z** but inhibited by solution **W;***

ii) Give two factors being investigated in the procedures above. (01 mark)

- *Effect of boiling/high temperature on enzyme activity;*
- *Effect of concentration of active substance on its activity;*
- *Effect of the nature of medium on the active substance activity;*

QUESTION 3: (26 marks)

You are provided with specimens **X(ferns), Y(mosses)** and **U(bread moulds)** which are plant parts. Examine the specimens using a hand lens.

a) giving reasons from your observations:-

i) classify the specimens into the following taxa:

Specimen **X** (06marks)

Phylum: - ***Filicinophyta***

Reason:-

- ***Sporangia on lower leaf surface/frond surface;***
- ***Well developed leaves/fronds or relatively large leaves;***
- ***Leaflets alternately/oppositely arranged along the rachis/stem***

Specimen **Y**

Class: - ***Musci***

Reason:-

- ***Small sized; stem with spirally arranged leaves;***
- ***Presence of thin rhizoids;***
- ***Prominent spore bearing capsule;***

Specimen **U**

Phylum:- ***Zygomycota/ Thalophyta***

Reason

Large well developed branching mycelia/mycelia of aseptate hyphae; sporangia bearing spores

ii) Suggest the mode of nutrition in **specimen U**. (02 marks)

Mode of nutrition:- H***eterotrophic nutrition***

Reason

Lacks chlorophyll/not green in colour.

b) Describe:-

i) The location of named structures used for reproduction in each specimen.

Specimen X (06marks)

- ***Clusters of sporangia/sori/sorus/spore case;***
- ***Lower/underside of the leaflet/frond/pinnule;***

Specimen Y

- ***Spore capsule/case/sporangia***
- ***At the tip of a stalk/elongated seta;***

Specimen U

- ***Sporangia /spore case***
- ***At the tip of long stalk/sporangiophore***

ii) two named vegetative structures in specimen **Y** (03 marks)

- ***Leaf; small sized;l;green;veined;***
- ***Stem; short; thin;green***
- ***Rhizoids; short;many ;thin***
- ***Stalk/seta;long;thin pale brown/green***

c) Suggest one advantage of the location of the reproductive parts as described for specimen **X** and **U** (02 marks)

Specimen **X**

Sorus/sori under side/lower side of the leaf/frond-to be well protected

Specimen **U**

Sporangia held high over /at the tip of sporangiophore for easy dispersal of spores;

d) State one advantage and disadvantage specimens **Y and U** have in colonizing new habitats. (04 marks)

Specimen Y

Advantage

Small sized-less visible; many rhizoids-for anchorage/absorption of nutrients; green-for photosynthesis; spore capsule bearing spores for sporulation

Disadvantage

Many growing close to each other; competition for nutrients or easily noticed/predated on
Small sized-easily destroyed;

Specimen U

Advantage

Sporangia bearing many spores –for easy sporulation;
Small sized-less visible;

Disadvantage

Forms many branching mycelia –easily noticed;

e) Remove one leaf from **specimen X** observe the reproductive structure under low power magnification.

i) Describe the structures observed (02 marks)

Many sporangia; brown; closely packed; indusium/capsules with lines of weakness/sutures;

ii) Explain how the structure observed in e) i) above are adapted for reproduction. (01 marks)

- ***Many sporangia; bearing many spores for faster sporulation;***

- *Closely packed-sporangia to be well supported;*
- *Capsules/indusium with lines of weakness to easily break open for spore dispersal;*

RESOURCEFULL MOCK 3

Question 1

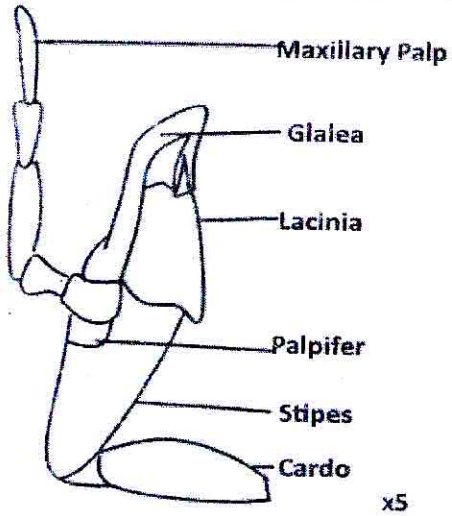
You are provided with specimens **R** (cockroach) which is fleshy killed.

a) Examine the antennae and describe how they are adapted to their function. **(3mks)**

- *They are long to sense a large area around the body/detect changes around at a distance.*
- *They are thin for easy swinging in all direction for increased sensitivity.*
- *They joined /segmented to increase their flexibility.*
- *Are tapering for easy swinging in all directions*

ii) Carefully cut off the whole left maxilla. Observe using a hand lens. Draw and label. (6mks)

Drawing showing the keft maxilla of specimen R



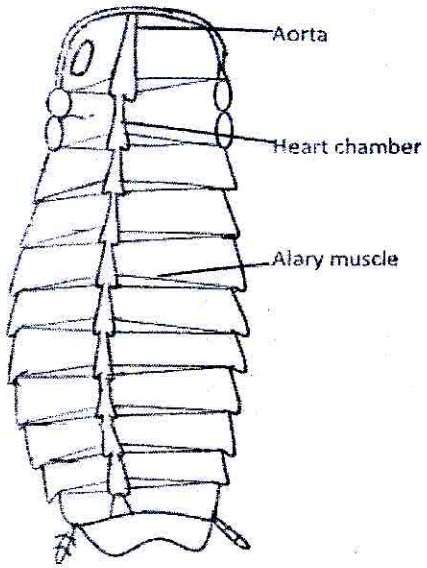
x5

iii) Give three adaptations of maxilla to its functions. **(3mks)**

- *long maxillary palps to reach food at a distance /grasping food into the mouthat a distance*
- *Segmented maxillary palps for flexibility while pushing food into the mouth*
- *Having the lacinia and galea are hooked for holding food.*
- *Having lacinia has sharp edges for cutting food.*
- *Hairy maxillary palps to increase its sensitivity to food(microscopic point)*

b i) place the specimen dorsal side uppermost .cut along one lateral line of the specimen to display the heart .draw and label the circulatory system. (8mks)

Drawing showing the circulatory system of specimen R



c) Remove both the crop and the gizzard related to the function of the two organs? (4mks)

i) Describe the appearance of the inner surface of:

Crop

It is enlarged, conical shaped and consists of elastic muscular wall with smooth folded inner lining and wide lumen.

Gizzard

Its lumen is narrow and reduced by infoldings of the wall and has six principal folds which are highly sclerotized/ hardened thickenings ending in pointed teeth.

ii) How are the inner surface of the crop and gizzard related to the functions of the two organs? **(4mks)**

Crop

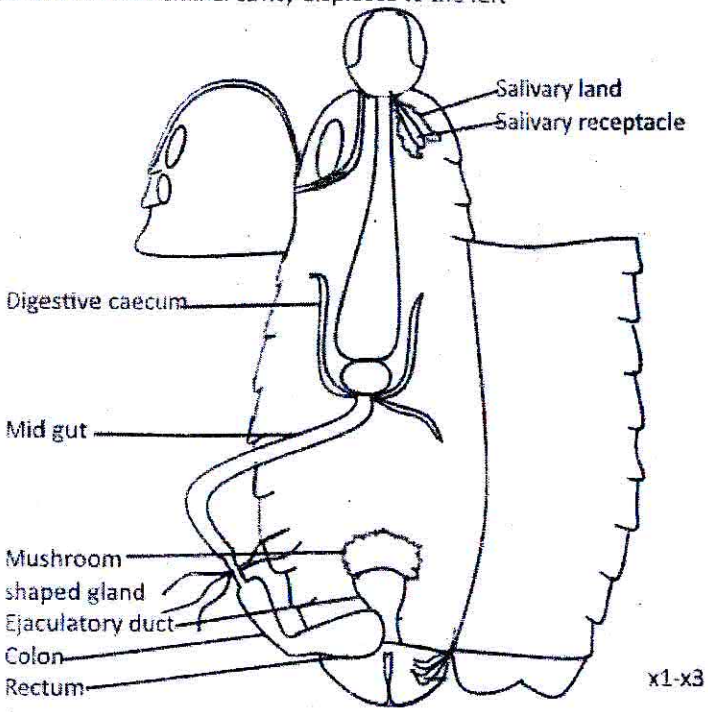
- *Folded inner lining is to increase the surface area for digestion of food.*
- *It is Elastic and folded to easily stretch and accommodate /store food.*
- *Smooth inner lining for easy passage of food.*

Gizzard

- Folded inner lining to increase the surface area for digestion of food.
- Toothed /Six ridges for physical/mechanical digestion of the food.
- Thick muscular wall to generate powerful contraction during crushing of the food.

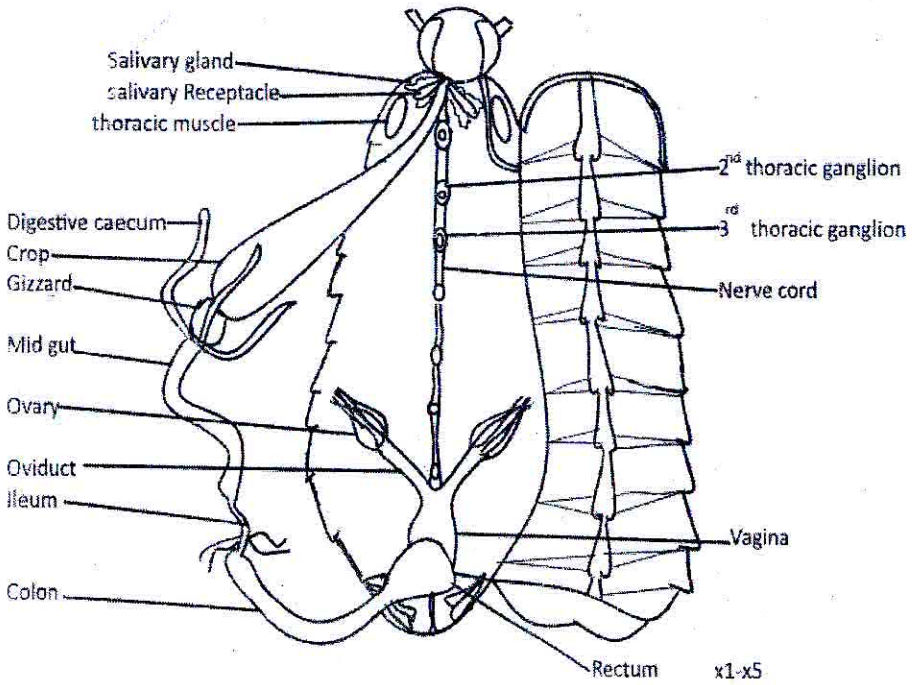
d) Place the specimen on the dissecting tray with dorsal surface uppermost. Cut along the left lateral side of the abdomen to open up the abdominal cavity. Also cut along the right lateral side of thorax to open up the thoracic cavity.fix the crop with a pin in its original position. Immerse the dissection in water. Displace the alimentary canal in the abdominal cavity to the left. Draw and label the secretory and absorptive structures displayed

Drawing of the secretory and absorptive structures of specimen P,alimentary canal within the abdominal cavity displaced to the left



e) Dissect the specimen to remove the whole dorsal cuticle. Discard this cuticle. Then clear off the fat to display the structures on the ventral cuticle. Displace only the intestines to the left of the specimen. Draw and label the visible internal structures. **(19 marks)**

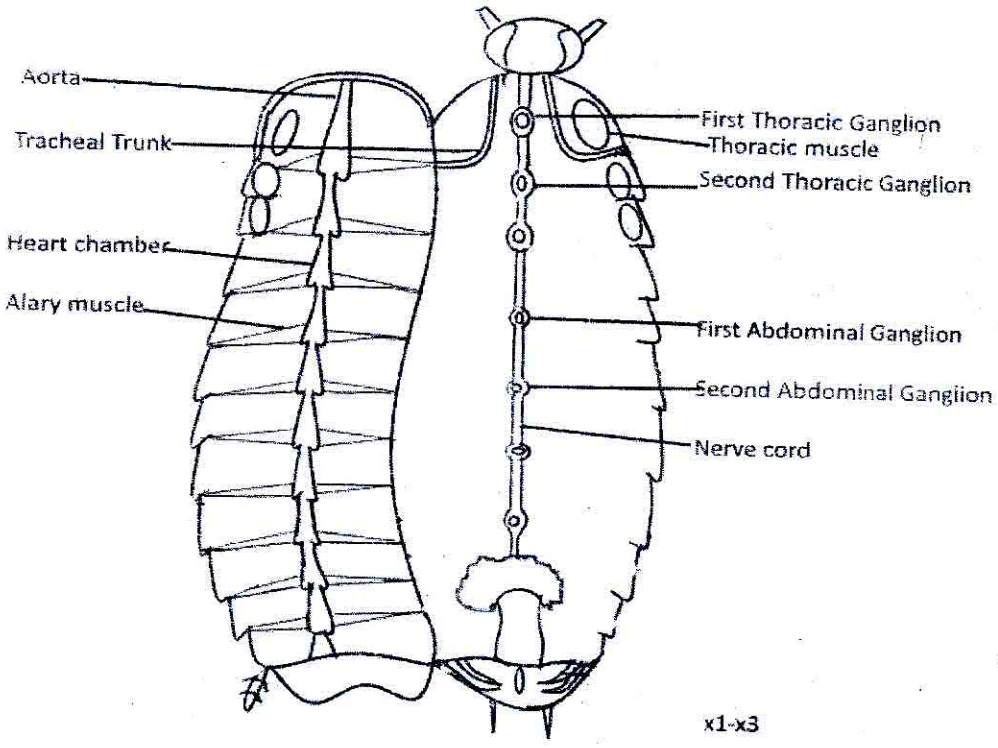
Drawing of the internal structures on the ventral cuticle with intestines displaced to the left of specimen P



f) Dissect the specimen furher to diplay non-buoyant internal structures of both the ventral and dorsal cuticles.

(16 marks)

A Drawing of the Non-buoyant internal structures of specimen P with the Reproductive structures intact



RESOURCEFULL MOCK 4

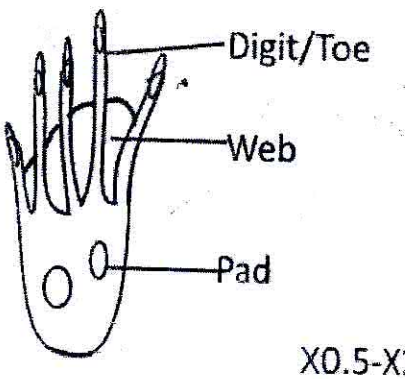
Question 1

You are provided with a freshly killed animal labeled **M (Toad)**

a) Examine the hind and fore feet of the animal.

i) Draw and label one hind foot from the ventral side.

Drawing showing the ventral side of the foot of the hind limb of specimen M



DL-03
M-0.5
T-0.5
N-0.5
O-05
T-05

X0.5-X2

ii) State the differences between the hind foot digits and fore foot digits

Fore digits	Hind digits
i) Free digits/No webs between the digits	***Have web between the digits***
ii) end in four well developed digits	***end in five well developed digits***
iii) shorter digits ***iv) digits with fewer joints***	***Longer digits*** ***Digits with many joints***

iii) State the significance of any one difference between the fore foot and hind foot to the mode of life of the animal.

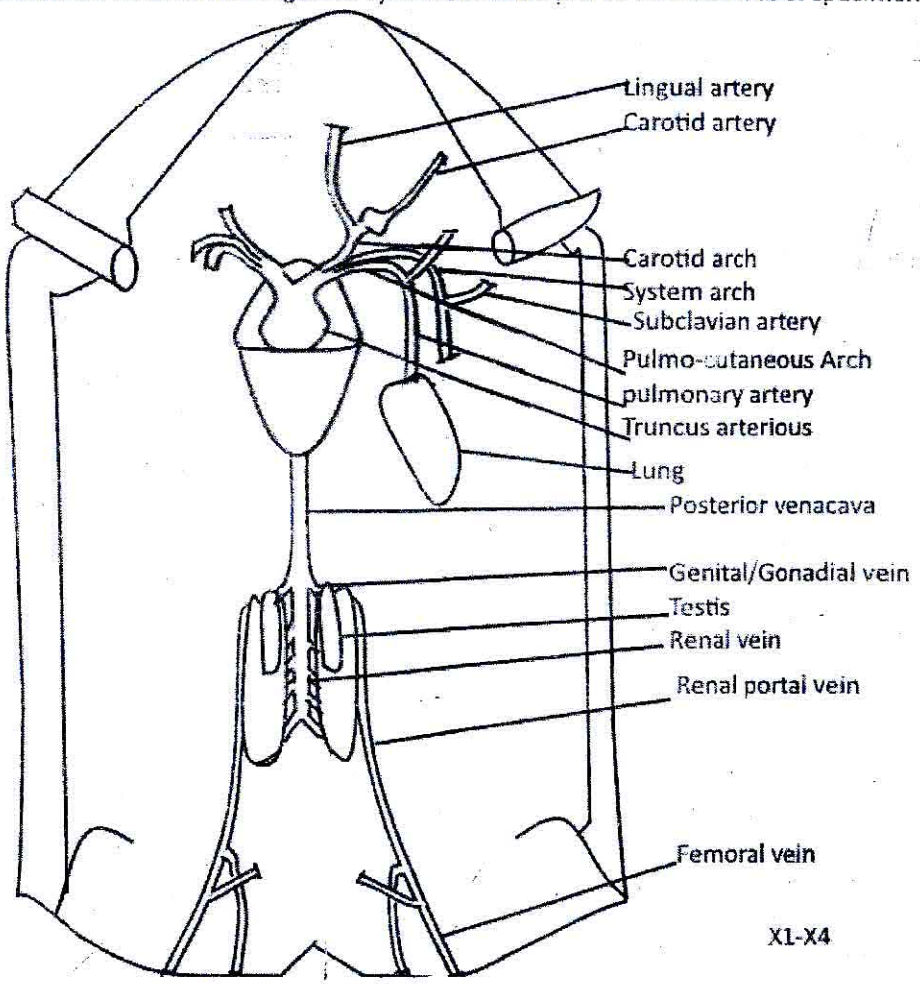
- ***Wedded digits; increased surface area for swimming;***
- ***Five digits; for support/stability;***
- ***Longer digits; for grasping/firm griping;***
- ***Many joints; for flexibility when grasping;***

iv) Identify three structures on the head of the specimen that are used for sensitivity and for each structure, describe its suitability to the role it performs. **(05mrks)**

- *Large protruding/dorso-laterally located eyes for wide field of view/better view/clear seeing.*
- *Large mouth to provide a wide gape for capturing/ingesting prey of large size.*
- *A pair of naris/nares/small holes/nostrils located at the tip of head/snout to ease breathing on land/when submerged in water.**rej** gaseous exchange/help in breathing*
- *Flat ear drum/tympanic membrane to allow for streamline shape **or** it's being circular gives it a wide surface area for receiving sound waves and It is a stretched membrane to easily vibrate upon receiving sound waves to make hearing easy.*

c) Dissect the specimen to search for blood vessels that supply blood to the left hand side of the head, fore limb and lung. Further trace for routes of blood flow, draining the urinogenital system and outer part of the hind limb .without displacing the heart. Draw and label your dissection. (25 marks)

Drawing showing blood vessels that supply blood to the left hand side of the head, fore limb and lungs and those that drain blood from the urinogenital system and outer part of the hind limb of specimen M



T-01
D-08
M-01
A-01
N-01
L-08
O-01
2KID-01
2LMB-01
T=24

QUESTION 2 (37MARKS) **(66MINUTES**

B**=Beans soaked **for 72 hours/2.5/3 days
C**=maize seeds soaked **for 72 days
D**=maize seed soaked for **24 hours
***P**=**20vol** hydrogen peroxide*
***A**=large Irish potato*

You are provided with specimens **A, B, C, D and solution P** .specimen **B, C and D** are at different stages of growth.

a) Peel one half of specimen **A** and cut the peeled half into small pieces. Crush them into fine paste using a motor and a pestle. Transfer the paste into a clean beaker and add 25cm^3 of distilled water.mix well and leave to stand for 2 minutes. Decant to obtain an extract. Heat the extract to a temperature of 60^{o}C.leave to cool and label it extract **A**. Carry out tests indicated in the table 1 below on the extract. Record your tests, observations and conclusions. (12marks)

Test	*Observations*	*Conclusions*
Iodine test *To **1cm³** of solution A was added **2/3 drops** of **iodine solution***	*Turbid suspension turned to blue-black solution;*	*Much starch present;*
Reducing sugar test To ***1cm³*** of solution A was added ***1cm³*** of ***Benedict's Solution*** and ***boil*** for 2 min	*Turbid solution turned to pale blue solution which on boiling turned to green solution/blue solution;*	*Little reducing sugars present;*
Biuret test To ***1cm³*** of Solution A was added ***1cm³*** of ***NaOH solution*** followed by ***2/3 drops*** of ***$CuSO_4$ solution***	*Turbid solution turned to pale blue solution then to pale purple solution;*	*Little proteins present;*

b) Obtain 10 seeds /seedlings from each of the **lots B, C and D**.remove the radical/plumule if present. Crush them separately to obtain fine pastes. Add 15cm^3 of distilled water.mix well then leave to stand for 10 minutes. Decant to obtain only the clear part and transfer into separate test tubes. Label them accordingly. Now obtain three test tubes and label the 1-3.to all add 1 cm^3 of extract **A** .to test tube 1 add 1 cm3 of **B** ,to test 2 add 1 cm3 of **C** and to test tube 3 add 1 cm^3 of solution **D.**

Table 2 shows a summary of the test tubes and their contents.

Table 2

Test tube	Content
1	1 cm3 of solution A + 1 cm3 of solution B
2	1 cm3 of solution A + 1 cm3 of solution C
3	1 cm3 of solution A + 1 cm3 of solution D

Incubate all the three test tubes in a water bath maintained at **35 - 40° C for 40** minutes shaking periodically. After this time, record your observations and conclusions in table 3 below. **(06marks)**

Table 3.

Test tube	Contents	Observations	conclusions
1	1 cm^3 of **solution A** + 1 cm^3 of solution B	***Turbid Mixture completely clears***	***Solution A Complete hydrolysis***
2	1 cm^3 of solution **A** + 1 cm^3 of solution **C**	***Turbid solution partially clears***	***Solution A was partially hydrolyzed***
3	1 cm^3 of solution **A** + 1 cm^3 of solution **D**	***Turbid Solution remains turbid***	***No hydrolysis of A***

C) Obtain three test tubes 4-6 .to all add 2 cm^3 of **solution P**. follow the instructions in the **table 4** below to add the remaining components in the test tubes.

Test tube 4

Test tube	Content
4	1 cm3 of solution **P** + 1 cm^3 of solution **B**
5	1 cm3 of solution **P** + 1 cm^{3}of solution **C**
6	1 cm3 of solution **P** + 1 cm^3 of solution **D**

Record your observations and conclusions in the table **5** below.

Test tube	Contents	observations	conclusions
3	1 cm^3 of solution **P** + 1 cm^3 of solution **B**	***many bubbles/Fast rate of bubbling***	***Rapid decomposition of solution P***
4	1 cm^3 of solution **P** + 1 cm^3 of solution **C**	***moderate bubbles***	***Moderate decomposition of solution P***
5	1 cm^3 of solution **P** + 1 cm^3 of solution **D**	***few bubbles/slow rate of bubbling***	***Slow decomposition of solution P***

c) Explain your results in the following test tables:

i) Table 3

*During germination enzymes are activated which catalyse the hydrolysis of the complex food substance in **A** giving a clear solution. The more the days of growth, the greater is the clearity. **Solution B** has both protease and amylase ,so there is complete hydrolysis of solution **A**, and **Solution C** has only amylase so there is partial hydrolysis of solution **A** but no hydrolysis of solution **A** by solution **D** because few or no enzymes have been activated.*

ii) Table 5

Growth is associated with increase in metabolism and release of metabolic waste such H_2O_2.
H_2O_2 is toxic so more catalase enzyme is secreted to catalyse its break down/decomposition.
*The more the days of growth, the greater is metabolic wastes and the higher the concentration of catalase which rapidly decomposed **P. hence** growth is in the order **B>C>D.***

b) What is the biological significance of the results in table 5.

- ***Break down of toxic waste products***

c) What was the purpose of the following operations in this experiment?

i) Heating extract A to 60^oC

To allow starch in the specimen A to dissolve, so that the enzyme can catalyse the hydrolysis of cooked starch.

iii) Leaving the extracts **B, C, D** to stand for 10 minutes.

To allow the enzymes in solution to separate out since they are soluble

RESOURCEFULL MOCK 5

QUESTION 1

You are provided with a freshly killed specimen **K (rat)**.Observe it carefully and then answer the following questions.

a) i) State how the shape of the head and eyes of the animal enhance its survival in its natural habitat

- ***Head id stream lined shape/head tapers anteriorly; to minimize air résistance; for easy movement on land/for easy burrowing in the ground;***
- ***Eyes are large/oval/round/spherical and anterio-laterally located to provide a wide field of view/for increased surface area for vision.***

ii) State the type of teeth possessed by the specimen giving reasons for your answer

Heterodont teeth

Reasons

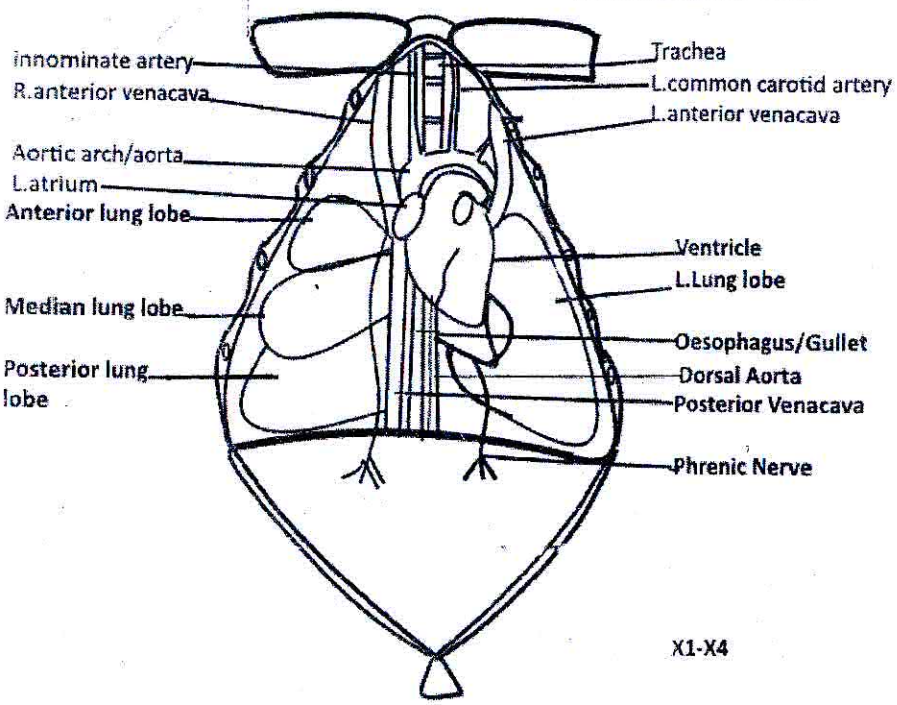
- ***Different in shape***
- ***Different in size***
- ***Different in structure and number***

iii) Carry out the dissection of the specimen the following procedure.

Pin the animal with ventral side uppermost .remove the skin of the thoracic region including the neck .lift the xiphoid cartilage and cut along the lower edge of the rib cage. The tie the xiphoid cartilage .pull it back and pin it down .cut along the sidewall of the thorax on both sides to remove the rib cage. Remove the thymus gland to display the major vessels from the heart.

Draw and label the structures in the thoracic region in undisturbed state.

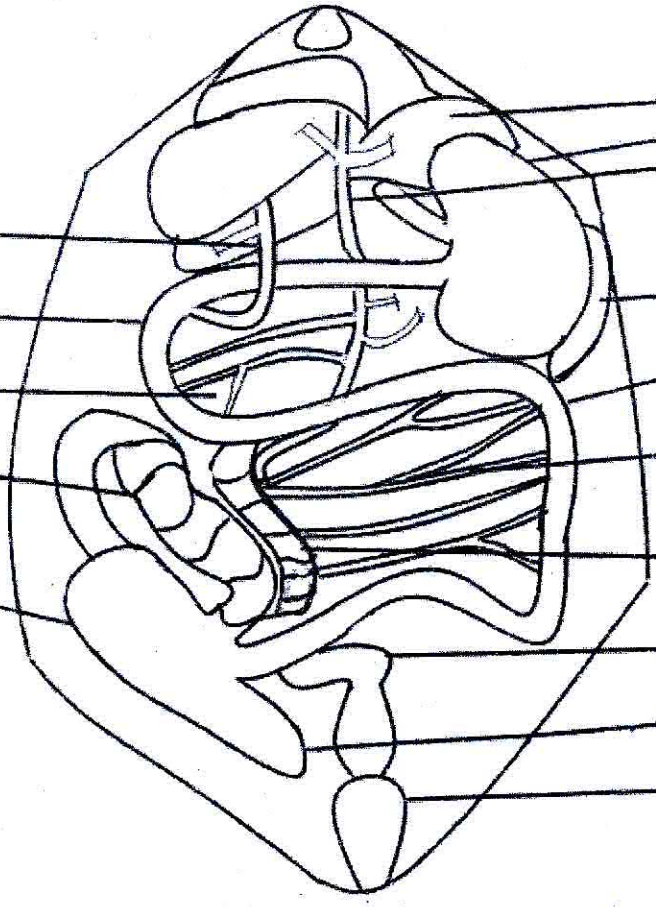
Drawing showing structures in the thorcic region in undisturbed state and major blood vessels from the heart after the thymus gland has been discarded/removed of specimen T



X1-X4

b) Dissect the specimen to display the contents of the abdominal cavity. Displace the duodenal loop to the right of the specimen, and then turn the bulk of the ileum to the left of the specimen. Displace the colon and the caecum downwards to the right of the specimen to display the vessels that carry blood from the alimentary canal to the liver which is displaced anteriorly.
Draw and label structures visible in the abdominal region in the space provided on. *(20 marks)*

Drawing showing abdominal structures after displacing the duodenal loop to the right and the bulk ileum to the left side the colon and the caecum downwards to the right of specimen T with the liver lobes displaced anteriorly



D-7.5
L-7.5
M-01
T-01
N-01
O-01
B-01
T=20

X1-X4

Question 2

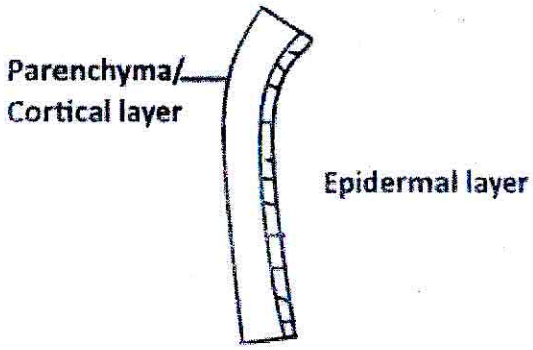
You are provided with specimen M (amaranthus stem) and sucrose solutions of different concentrations. **A (0.1M), B (0.2M), C (0.25) and D (0.15).** Cut two pieces of the stem of specimen M and then cut each stem longitudinally to obtain two strips of 5cm length of uniform thickness from each stem.
A i) immediately note what happens to the strips as soon as they are cut. (02marks)

Strips curved/curled/bent; outwards; with epidermal layer inwards and parenchyma/cortical layer/inner layer outwards;

iv) Explain your observations made (03marks)

Cutting epidermal tissue reduces/releases its restraining force/hydrostatic pressure on the cortical /inner layer cells; cortical cells slightly expand/volume of cortex increases to push epidermal tissue inwards of the curve;

v) Draw and label one strip as it appears two minutes after it is cut. (02marks)



Rej C or U shapes
Accept Inner layer for cortex layer

b) Place one separate strip into each of the solutions A; B; C and D in the petri dishes and leave each to stand for 45 minutes.

i) After 45 minutes while strips are still in solutions, measure distance ,**d,** in **mm** and record your "**d**"

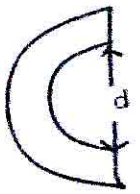


Table 1 **(06 marks)**

Sucrose solution	Distance,d/mm	Conclusion
A(0.1M)	***43;***	*Strip curved/curled further outwards; most;*
B(0.2M)	***45.0-49.0***	*Strip curved/curled further outwards; slightly/less;*
C(0.25M)	***49.0-49.5***	*Strip curved/curled further outwards; least;*
D(0.15M)	***45.0-48.0***	*Strip curved/curled further outwards; moderately/more;*

In the table below, describe the nature of the curvature of each strip in each solution and explain in each case the observations made in b (i) **(20 marks)**

Sucrose solution	Description	Explanation
A(0.1M)	*Strip curved/curled further outwards; with epidermis inwards and cortical*	*Solution **A** is hypotonic to the cell sap of the fleshy layer/cortical cells; much/largest amounts of water absorbed across the cortical surface; by osmosis;*

Rej solution moves	*tissue/inner layer outwards; to form a complete ring or **U**-shape*	*Cortical cells /parenchyma layer become most turgid and the expands pushing epidermis inwards;*
B(0.2M)	*Strip curved/curled further outwards; with epidermis inwards and cortical tissue/inner layer outwards; to form **J/I** – shape;*	*Solution **B** is hypotonic to the cell sap of the fleshy layer/cortical cells; much/largest amounts of water absorbed across the cortical surface; by osmosis;* *Cortical cells /parenchyma layer become less turgid /expanded pushing epidermis inwards to form a **j / I** - shape;*
C(0.25M)	*Strip curved/curled further outwards; with epidermis inwards and cortical tissue/inner layer outwards; to form **I** –shape;*	*strip absorbed least amounts of water across the cortical surface by osmosis from solution C because of Solution **C** **being** hypotonic to the cell sap of the fleshy layer/cortical cells;* *Cortical cells /parenchyma layer become least turgid /least expanded hence pushing epidermal tissue/cells inwards to form a **I** - shape;*
D(0.15M)	*Strip curved/curled further outwards; with epidermis inwards and cortical tissue/inner layer outwards; to form a complete ring or **C**-shape*	*strip absorbed moderate amounts of water across the cortical surface by osmosis from solution **D** because of Solution **D** **being** hypotonic to the cell sap of the fleshy layer/cortical cells;* *Cortical cells /parenchyma layer become moderately turgid /moderately expanded hence pushing epidermal tissue/cells inwards to form a **C** - shape;*

ii) Arrange the solutions in order of decreasing water potential. **(01mark)**

A; D; B; C ***or*** ***A>D>B>C***

Question 3

you are provided with specimen **B**(water Lilly leaf),C_1(sunny/open commelina) ;C_2 (shade plant commelina) ,D_1(dicotyledonous root system),and D_2(monocotyledonous root System).$C_1$and C_2 are whole plants while **B**, D_1,and D_2 **are plants parts.** Specimens **B**, D_1, **and** D_2 are each from a different habitat

a) State three observable differences between specimen C_1 **and** C_2. (03mks)

C_1 -open sun /lit	**C_2- Shade/shady/dim light**
• *Pale Green-less chlorophyll -exposed to much sun light.*	• *Dark green/much chlorophyll for max light absorption*
• *Narrow/short leaves*	• *Broad/longer leaves*
• *More hairy Leaves*	• *Less hairy leaves*
• *Thin leaf surface*	• *Thick lamina*
• *Short internodes*	• *Longer internodes*
• *Thin/smaller stems*	• *Thick/bigger stems*

b).Obtain a small piece of the epidermis from the upper surface of specimen **B**.Mount each epidermis in a drop of water, one at a time. View under low power of a microscope, count and record the number of stomata in a field of view, for each surface, in the table below.repeat the procedure with leaves of specimens C_1 **and** C_2

Specimen	surface	No. of stomata
B(water lilly)	upper	***100+***
	lower	***none***
C_1(sunny plant)	Upper	***30-50 or 100-150***
	Lower	***150-400***
C_2(shade plant)	Upper	***50-150***
	lower	***250-500***

C i) Suggest a suitable habitat from which each specimen was obtained

B: *water/wetland/aquatic habitat*

C_1: *Sunny/open/dry area terrestrial habitat*

C_2: *shady/damp /humid area terrestrial habitat*

ii) State adaptations of each specimen to its habitat stated in (c) (i)

Specimen B

- Has many stomata on the upper surface so as to get rid of excess water;
- No stomata on lower surface of the leaf since its submerged /stomata would play no role
- Large surface area for floatation/increase surface is for evaporation/for maximum photosynthesis.
- Long leaf stalk/petiole for floatation/receive light for photosynthesis
- Hollow leaf stalk for floatation;

Specimen C_1

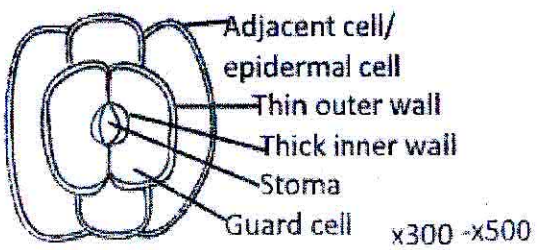
- Fewer number of stomata on upper/more on lower surface to reduce water loss
- More hairy to reduce rate of water loss/trapping water vapour increasing humidity
- Narrow leaf surface to reduce Surface area to minimize water loss.

Specimen C_2

- Few stomata on the upper /more number of stomata to reduce water loss.
- Darker green to maximize capture of light for photosynthesis
- Broad /larger leaves to increase surface area exposed to sunlight/for max light absorption
- Less hairy as there is little danger of water loss

d) Draw and label a stoma from specimen C_1 (07mks)

Drawing of stoma from specimen C 1 observed under low power of the microscope



DL-05
M-0.5
T-0.5
N-0.5
N.C-0.5
T-07

h) (i) state one difference between specimen D_1 and D_2

- D_2 has Fibrous root system WHILE D_1 has tap root system

ii) Giving reasons, state two advantages of specimen D_1 and D_2

.....
.....
.....

RESOURCEFULL MOCK 6

Question 1: **65 minutes (38 marks)**

You are provided with a freshly killed animal labeled **R**

a) Examine the characteristic features of the tail. Giving reasons from your observations; state the class to which the specimen belongs. **(02 marks)**

Class: *Mammalia*

Reason*; presence of fur/hairs*

b) Observe the scales on the tail using a hand lens.

i) Describe the attachment and pattern of arrangement of the scales. **(03marks)**

Anterior end attached; posterior end free; arranged close to each other; anterior scales overlaps posterior scales in rows; and scales in the next row lies in between these in the previous row.

iii) Suggest three adaptive advantages of your observations as recorded in (b) (i) above in the life of the animal. **(03marks)**

- *Overlap allows for heat escape*
- *Close to each other for protection*
- *Close to each other to conserve water*

c) Pin the specimen with its back on the board. Dissect to expose structures of the buccal cavity.

i) Describe the arrangement and types of teeth observed. (06marks)

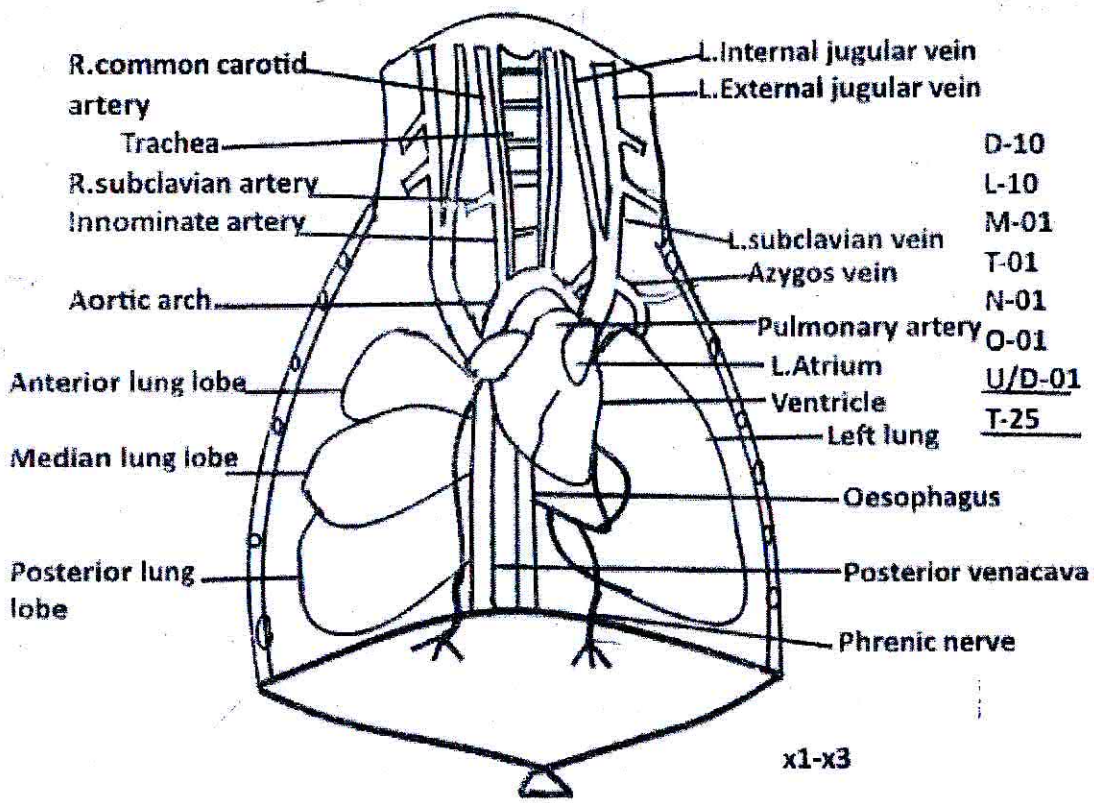
***Arrangement:** - a pair of incisors at front of both upper and lower jaws while three pairs of molars at the back of the upper and lower jaw;*
***Incisors:** - are hard; sharp top crown/chisel shaped; narrow; long; curved inwards*
***Molars;** - hard broad top surface; rough top surface; big sized;*

ii) Relate your description in (b) (ii) above to the effectiveness of the teeth in feeding. (***02*** marks)

- *Both hard molars at the back to exert maximum force for chewing food*
- *Incisors at the front to cut /chew food*
- *Broad top surface of molars to provide a large surface area for chewing food*
- *Chisel shape of incisor to cut food*

d) Now dissect the specimen further by opening the thorax and continue into the neck and display structures involved in movement of substances in the thoracic and neck region.
Draw and label the structures displayed with the heart in undisturbed state. ***(25 marks)***

Drawing showing structures involved in the movement of substances in the thoracic and neck region of specimen R with the heart in undisturbed state



e i) give the difference in the origin between the following vessels

- Left and right common carotid arteries.

Left common carotid artery originates from the aortic arch whereas the right common carotid artery originates from the innominate artery.

- Left and right subclavian arteries

Left subclavian artery originates from the aortic arch whereas the right subclavian artery originates from the innominate artery.

QUESTION 2 **(40marks)**

You are provided with suspensions **A (Irish potato Extract)** (which is *an extract from a plant organ*) and **B (10% sucrose)**. *Solutions* ***C (10 Volume hydrogen peroxide),*** **D (2% invertase)** *and* ***Y (0.05M $NaHCO_3$)*** *are common laboratory reagents. You are required to determine the effect of* ***solution D on suspension B***

a) Using the lab chemicals provided, carry out experiments to determine the composition of the two suspensions. In **test IV**, to 2 cm^3 of each suspension add 1cm^3 solution **C**.
Record your tests and observations in the table below **(12marks)**

Test	solution	Observations
i) STARCH TEST *To **1cm³** of solution A,B was added **2/3 drops** of **iodine** solution*	**A**	The turbid suspension turns to blue-black solution/black solution;
	B	The colourless solution turned pale brown solution;
ii) BIURET TEST *To **1cm³** of Solution A,B was added **1cm³** of **NaOH** solution followed by **2/3 drops** of **$CuSO_4$** solution*	**A**	The turbid solution turned blue solution then to pale purple solution.
	B	The turbid solution turned to pale blue solution.
iii) DCPIP TEST To **1cm³** of **DCPIP solution** was added solution A,B **drop wise** till excess	**A**	Blue solution persisted
	B	Blue solution persisted
iv) To 1cm3 of solution A,B ADD 2cm³ of solution C	**A**	Many bubbles of colourless gas
	B	No bubbles of colourless gas evolved

b) Giving two reasons for your observations, name the suspension with,
i) a complex composition (02marks)

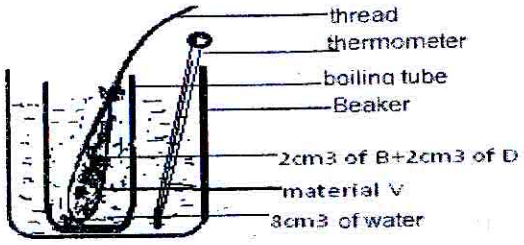
Suspension
A
Reasons
Contained much starch; little reducing sugars and little amount of proteins;

ii) an active substance only (02marks)
Suspension
A
Reasons

*Produced bubbles of colourless gas when solution **C** was added; suggesting that it contains catalase enzyme that decomposed solution **C***

b) To **2cm³** of the suspension **B** add **2**cm^3 of solution **D**.
Transfer the contents of the tube into material **V** provided. Tie the open ends of material **V** tightly using a thread. Suspend the material and its contents into a boiling tube containing **15** cm^3 of water and incubate the mixture at a temperature of **40°C**.

Carry out the Benedict's test on the warm water in the boiling tube after **5** min, **20** minutes and **40** minutes.



Record your test, observations and deduction. **(08 MKS)**

TEST	TIME/ MIN	OBSERVATIONS	DEDUCTIONS
To 1cm³; of solution was added 1cm³; of Benedict's Solution; and boil; for 2 min	**5 min**	*Green solution*	*Liitle reducing sugars present*
	10min	*Yellow ppt*	*Moderate reducing sugars present*
	30min	*Orange ppt*	*Much reducing sugars present*

i) Giving evidence from your observations in (a) and (b) ,comment on the nature of **Solution D (02mks)**

Enzyme/organic catalyst

- It catalysed the hydrolysis of solution B to reducing sugars
- It catalyses the hydrolysis of solution B in optimum temperature between 35-40^{0}C

Material V **(02mks)**

Semi permeable membrane:-Allowed diffusion of reducing sugars into the water.

iii) Relate the results obtained in (d) above to similar physiological activity in humans. **(06marks)**

The results show that digestion of non-reducing sugars by the active substance in solution D occurred; which is a similar process that occurs in the ileum of the gut and the resulting soluble diffusible food substances diffuse into the blood stream via the thin permeable membranes for transport to the body tissues. The extent of digestion also increases with increase in the time of incubation. This is related to the ileum being lowing allowing more time for the complex food substance to be hydrolyzed by the hydrolytic enzyme/sucrase to soluble diffusible ones.

SECTION 2: PHYSIOLOGY

The table below contains standard chemical tests, expected observations and conclusion for food substances.

	Food substance	Chemical test	observation	conclusion
1	**starch**	To **1cm^3** of food substance add **2 drops** of **iodine solution**	The colourless solution turned pale brown solution/yellow solution	Starch absent
			The turbid solution turns to pale black solution/specks of blue-black solution.	Little starch present
			The turbid solution changed to blue-black/black solution	Much starch present
2	**Reducing sugars**	To **1cm^3** of food substance add **1cm^3** of **Benedict's Solution** and **boil** for 2 min	The colourless solution turned pale blue solution and remained pale blue on boiling	Reducing sugars absent
			The colourless solution turned pale blue solution then on boiling it turned to green solution.	Little reducing sugars present.
			The colourless solution turned pale blue solution which on boiling turned to green solution, yellow precipitate	Moderate amount of reducing sugars present
			The colourless solution turned to pale blue solution, which on boiling turned to green solution, yellow ppt, and then to orange precipitate.	Much reducing Sugars present.
			The colourless mixture turned to pale blue solution, which on boiling the mixture turned to green solution, then to yellow ppt , to orange ppt and finally to **brown /red ppt**	Very much reducing sugars present
3	**Non-reducing sugars.**	To 1cm^{3}of food Substance, add 1cm^3 of dilute HCl, boil and then cool. Add 2cm^3 of dilute NaOH solution ,followed by 1 cm^3 of Benedict's solution and finally boil the mixture	The colourless solution turned to pale blue solution, which persisted on boiling	Non reducing sugars absent
			The colourless solution turned to pale blue solution, which turned to green solution on boiling	Little non reducing sugars present.
			The colourless solution turned to pale blue solution, which on boiling turned to green solution then to yellow precipitate	Moderate non reducing sugars present.
			The colorless solution turned to pale blue solution ,which on boiling turned to green solution, yellow precipitate, then to orange precipitate/brown ppt.	Much non reducing sugars present.

4	**Protein test**	To $1cm^3$ of food Solution add $1cm^3$ of dilute NaOH solution followed by 2 drops of $CuSO_4$ solution	The turbid solution turned to pale blue solution.	Proteins absent
			The turbid solution turned then to pale purple solution.	Little proteins present.
			The turbid solution turned to intense purple/violet solution.	Much proteins present.
5	**Lipid test**	To $1cm^3$ of food Solution add 5 drops of ethanol then add 3 drops of water and shake	The colourless solution remains clear.	Lipids absent
			The colourless solution turns to turbid suspension or white emulsion	Lipids present.
6	**Vitamin C**	To $1cm^3$ of DCPIP solution add food mixture drop wise till excess	Blue solution persists	Vitamin C is absent.
			Blue solution turned to colourless solution	Vitamin C is present.

NOTE

Amount of vitamin C in the solution is indicated by how fast the solution decolourises the DCPIP solution. The faster the solution it decolourises the DCPIP solution the higher the concentration of vitamin C .If a given solution requires fewer drops to decolourise the same amount of DCPIP ,then it has a higher concentration of vitamin C .

Boiling of the vitamin C solution lowers its concentration and thus it requires more drops to decolourise the same amount of DCPIP solution. This is due to evaporation and broken down and hence the less the concentration of vitamin C in the solution. if the locules/segments of orange or plant tissues boiled in the water the concentration of vitamin C in the juice lowers because most of the vitamin C diffuses into the water as the membranes of locules become more permeable with the boiling .

Further still as locules boil, water diffuses into locule and dilutes the concentration of vit.C.The more the boiling of locules, the more water enters locules and hence the lower the concentration of vitamin C in the juice.

The only way to know that vitamin C in the locules is decreasing in concentration is to test for it with DCPIP solution. The juice of the locules that are boiled for long will require more drops to decolurise the same amount of DCPIP solution. The water within which the locules are boiled tests positive for vitamin C.This confirms the diffusion of the vitamin C into the water from locules.

The Knowledge of break down of the vitamin C by heat helps the scientists to maintain high concentration of it in the fruits by; avoiding over boiling of fruits and vegetable, slightly boil the fruits in little water, store the fruits in cold places or where possible eat row fruits.

If the food solution is added to DCPIP solution; it turns to pink solution when vitamin C is present in little amounts. When vitamin C is absent, the blue solution persists. The concentration vitamin C is indicated by the number of drops of solution required to turn DCPIP solution to colourless solution. The more the number of Drops of solution required to decolourise the blue colour of DCPIP Solution to colourless, the lower the concentration of vitamin C present in the solution/extract.

In the chemical test, the word drops implies solution because droppers are only on the solutions.

ENZYMES AND ENZYME ACTIVITY

Introduction:

Enzymes are organic catalysts of high molecules weight, with complex structure .they in the protoplasm of living cells .Because they are proteins, their properties are proper proteins. The essential role of enzymes is to lower the amount of activation energy required to initiate a particular reaction.

Enzymes are specific in their action in that a single enzyme will only catalyse a single chemical reaction. An enzyme operates by becoming temporarily interlocked with the substrate molecules (template or lock –and key-theory) and its ability to catalyse the reaction depends on the closeness of the theory.

Their activity is affected by environmental factors like temperature and PH.They are named by adding the suffix"-ase" to the name of the substrate on which the enzyme acts, e.g. starch enzymes are **amylases**, protein enzymes are **proteases**, urea enzymes **ureases**, maltose enzymes maltases. However, other enzymes do not fall into this normal type of nomenclature, e.g the amylase, of saliva called "ptyalin, that extracted from barley, diastase""

Classification of enzymes

Hydrolytic enzymes; these are enzymes that catalyze the breakdown of/hydrolyze the food substances in presence of water a process called hydrolysis.

a) those enzymes that catalyses break down of some carbohydrates
   i) **Diastase /amylase** that catalyses the breakdown of **starch** into reducing sugars under suitable conditions like alkaline medium and favorable temperature.
   ii) **Sucrase or invertase** that catalyses breakdown of sucrose into reducing sugars under alkaline medium and favorable temperature
b) **Proteolytic enzymes** these are enzymes that break down proteins e.g. pepsin and trypsin that catalyses the breakdown of insoluble large molecules of proteins into soluble molecules .proteins area large molecules which form turbid solution is incubated with protease enzyme ,it clears due to the breakdown of proteins into soluble smaller molecules.
c) Those catalyse the breakdown of lipids (fats) to soluble fatty acids and glycerol is **lipase.**

Oxidizing-reducing enzymes:

d) ENZYME CATALASE

This enzyme is found in all living tissues and dead cells lack catalase enzyme.

Catalase enzyme needs a suitable temperature of 37-40°C for its rapid decomposition of hydrogen peroxide. It speeds up metabolism. Like any other enzymes catalase enzyme is specific in its activity in that it only catalyses the decomposition of hydrogen peroxide into water and oxygen

E.g. hydrogen peroxide (H_2O_2) a toxic product of metabolism in tissues is broken down by catalase enzyme into H_2O and O_2 which are harmless.

$2H_2O_{2\,(aq)} \xrightarrow{\text{catalase}} 2H_2O_{(l)} + O_{2\,(g)}.$

Toxic — Harmless substance

When writing observation of the catalase reaction, the focus should be put on the rate of bubbling, Indicating whether it is slow /little/few, moderate (fast) or very fast effervescence.

Then conclusion must relate to the rate of effervescence by stating whether the rate of enzyme activity is low, high or highest.

The rate of enzyme activity depends on many factors like;

1.Surface area of the tissue containing the enzyme molecules or the concentration of the enzyme molecules .the higher the concentration of the enzyme molecules, the higher the collision of the enzyme molecules with the substrate and hence the faster the rate of reaction

2. Concentration of substrate (H_2O_2), its concentration is directly related to the rate of reaction.
The higher the concentration of the substrate molecules, the higher the collision of the substrate with the enzyme molecules at a time leading to higher rate of reaction
3. Medium of the solution .catalase is more active in the neutral solution, followed by alkaline solution; it is not active in acidic solution.
The rate of reaction of enzyme catalase can be measured by;

- Counting the number of bubbles or the amount of froth formed at a given time .the more the bubbles or froth the faster the rate of reaction.
- Noting the time taken for bubbling or the reaction to stop .the time of the reaction depends of many factors like concentration of the substrate or of the enzyme and the temperature of the medium.

NB. Evolution of O_2 gas leads to bubbling /effervescence or formation of the froth in the solution.
Note:

Conditions	**Observations**	**Conclusion**	**Explanation**
Boiled tissue/liver	no bubbles/ effervescence formed	No decomposition of H_2O_2	Catalase enzyme is denatured by high temperatures/boiling.
Ground pieces/cut into smaller pieces	**Very rapid reaction /rapid effervescence/very many bubbles**	**Very rapid/rapid** decomposition of H_2O_2	cutting of more pieces, large surface area exposed more active substance/catalase to breakdown/decompose hydrogen peroxide
Intact tissue	fewer bubbles/slower the effervescence	slow decomposition of H_2O_2	Small/Less surface area active substance/catalase enzyme exposed to decompose H_2O_2
Irish potato unpeeled cube	*Moderate/ few/ less/ slow reaction*	*Slow/moderate/decomposition of H_2O_2/ Slow break down of H_2O_2*	*The unpeeled side reduced on the amount of active substances/ enzyme and therefore slow decomposition of H_2O_2*
size of the tissue/ concentration of the enzyme I)*small cut tissue*	fewer bubbles/slower the effervescence	slow decomposition of H_2O_2	*Smaller in size; fewer number of enzyme molecules/low/less catalase enzyme concentration; which results into lowest/least chances of collision with H_2O_2/substrate molecules; slow rate of decomposition of H_2O_2. hence slow rate of reaction*
II)*bigger cut tissue*	**Very rapid reaction /rapid effervescence/very many bubbles**	**Very rapid/rapid** decomposition of H_2O_2	*big in size; high/much/more concentration of catalase enzyme which results into increased chances of collision with H_2O_2; high rate of decomposition/breakdown of H_2O_2* .hence *rapid enzyme activity/ rapid rate of reaction*
% of H_2O_2/substrate concentration	fewer bubbles/slower the effervescence	slow decomposition of H_2O_2	*Less substrate concentration /low% of H_2O_2 ; less/low chances of collisions with the catalase enzyme active site;*

i)*low % used/low volume*			*slow rate of decomposition of H_2O_2.*
ii) *higher % used/higher volume used*	**Very rapid reaction /rapid effervescence/very many bubbles**	**Very rapid/rapid** decomposition of H_2O_2	*Much substrate concentration/low% of H_2O_2; higher chances of collisions with the catalase enzyme active site. Hence rapid rate of decomposition of H_2O_2.*
pH *i)neutral medium*	*Very fast /rapid effervescence/very many bubbles given off*	*Very fast/rapid breakdown/ decomposition of H_2O_2*	*In neutral medium; the active substance/enzyme catalysed the breakdown of H_2O_2 at a very fast rate. Neutral PH medium is most suitable/highly favours the active substance to catalyse the breakdown of H_2O_2*
ii)Alkaline /basic medium	*Fast effervescence/many bubbles given off/moderate effervescence*	*Fast breakdown/ decomposition of H_2O_2/moderate breakdown*	*fast decomposition/breakdown because the medium is less suitable/less favourable for the active substance to catalyse the breakdown of H_2O_2*
iii)Acidic medium	*slow effervescence/few bubbles given off/ very few bubbles*	*slow breakdown/ decomposition of H_2O_2/very slow breakdown*	*Slow decomposition/breakdown of H_2O_2 because the acidic PH medium does not favour/not suitable for the active substance to catalyse the breakdown of H_2O_2*

The rate of breakdown of H_2O_2 can **be no decomposition or slow, fast (moderate), or very fast (rapid).**
With faster rate reaction/very fast effervescence, much froth is formed. The rate of froth formation depends on the rate of reaction. The reaction with faster rate, forms more froth in a given time. The growth of the froth can be measured by mixing the subtract **(H_2O_2)** with an enzyme in the measuring cylinder.
With faster rate reaction, froth is formed. The rate of froth formation depends on the rate of reaction. The reaction with faster rate forms more froth in a given time. The growth of the froth can be measured by mixing the substrate (H_2O_2) with an enzyme in the measuring cylinder.

e) **Zymase-** Is a complex of enzyme usually extracted from yeast cells; it breaks down glucose into ethanol.

Cheap sources of enzymes

1) Zymase, sucrase (optimum PH5) from yeast cells.
2) Proteolytic enzymes such as papain enzyme from fruits juices e.g. pineapples and paw paw .
3) Urease from extract of Soya bean seedlings with radicles2-3cm long.
4) Pepsin from extracts of stomach lining.
5) Diastase from barley and germinating maize seeds.
6) Catalase from extracts of living tissues liver muscles like liver muscles, leaf, potato, apple, pawpaw etc.

SECTION 3: PHYSIOLOGY OF GERMINATING SEEDS

Plant stores its food in the seeds in the complex forms like starch, proteins and oils. Seeds are storage organs of seed bearing plants .they mostly store carbohydrates in form of starch for example maize, sorghum and Soya peas. Some store mostly proteins e.g. beans and Soya beans while others store lipids e.g. ground nuts and cotton seeds.
During seed germination, the complex food substances are broken down by certain enzymes into simple soluble molecules that can be translocated (transported) to the growing points for various functions. For examples,
Starch is broken down (hydrolyzed) to reducing sugars (glucose) which are broken down (respired) to provide energy for the growing embryo during germination.
The longer the period of germination, the more the reducing sugars but the little the starch. This is because more starch is broken down into reducing sugars with increased days of germination.

However with longer period of germination (seven days), both starch and reducing sugars reduce in amount because almost all the carbohydrates have been utilized by germinating parts for energy and for structural materials like cellulose which is used in formation of cell wall.
Most seeds store relatively little proteins except some seeds like beans. During germination proteins are also broken down into simple molecules, the amino acids.

Amino acids are used during germination for structural purposes (formation of new cells) leading to growth Amino acids are also used in formation of enzymes .hence the amount of proteins in the seeds reduces with days of germination.

During germination the stored food is broken down or hydrolysed by seed enzymes into simple soluble molecules which are used for development of seedling. The soluble molecules are translocated from the storage regions to area of development from endosperm to the cytoplasm.
Hydrolysis of stored food increases with germination. This causes a decrease in the complex stored food molecules and an increase simple food molecule. Further increases in the period of germination leads to the decrease in both complex and simple molecules since are being used for germination.

- Amylase enzyme catalyses the hydrolysis or break down of Starch into reducing sugars leading to a decrease in starch and an increase in reducing sugars with germination. But after a week (7 days), the amount of reducing sugars in the seed also decreases because it is being respired for energy.
- Proteins are broken down into simple molecules by protease enzymes which are used for structural purposes. Thus protein amounts decreases with the progress of germination.
- Lipids are broken down by lipase enzyme leading to its decrease with germination.

EXPERIMENTS USED TO DETERMINE THE WATER POTENTIAL OF PLANT TISSUE.

Osmosis is the movement of solvent molecules (water) from a region of low solute concentration to a region of high solute concentration via a semi permeable membrane.
Low concentration region (solution) is dilute solution with more water and less dissolved solute while a **highly concentrated solution** is the one with more dissolved solute and less amount of water.
In terms of water concentration (amounts) ,water is highly concentrated in low concentrated(dilute) solution than in highly concentrated one.

Thus osmosis is well defined as movement of water molecules from where is highly concentrated to its low concentration through a semi permeable membrane.
Or osmosis is the diffusion of water molecules through a semi permeable membrane.
Semi permeable membrane is the one that allows only small molecules like water and prevent large ones from passing through it. Example of such a membrane includes cell membrane and visking tube.
Diffusion is the movement of solute molecules from a region of their high concentration to region low concentrated region. Both osmosis and diffusion are passive processes since they do not require any energy to occur.
Determination of osmotic pressure /potential of a plant tissue using standard solutions by basing on;

1. **CHANGE IN LENGTH OF PLANT TISSUES**

Osmotic pressure is the concentration of the plant tissue. Potato Cylinders of same length are place in different sucrose solutions.
The sucrose Solution, whose cylinder increased in length, is less concentrated compared to that of the cell sap of the plant tissue. Thus the cell sap of the plant tissue (the cylinder) absorbed water by osmosis from the solution and its cells expanded (became turgid) leading to increase in total length of the ***hard, rigid, rough, swollen and stiff cylinders.***
The solution, whose cylinders decreased in length, is highly concentrated compared to that of the cell sap plant tissue. Thus the cell sap of the plant tissue (the cylinders) lost water by osmosis to the highly concentrated solution and its cells became flaccid (flabby) leading to a decrease in length ***of a smooth, soft, flabby cylinder.***
The solution, whose cylinder almost remained with the same length, shows that the concentration of the external solution and that of the cell sap of plant tissue are the same. In other wards they are **isotonic. There was no net loss or gain of water by both solutions/water molecule movement was in both solution was at equilibrium**

CHANGE IN LENGTH OF THE POTATO CYLINDERS

Cylinders of same length and diameter are immersed in solutions of different concentration and left to stand for 45-60 minutes, remove the cylinders and accurately measure and record the final length and diameter .then obtain the difference in the length and diameter.
The solution, in which the change in the length and diameter is almost zero, is isotonic to the plant tissue.
The cylinders placed in hypotonic solution absorb water by osmosis and increase in length and diameter .thus the change in the length and diameter is positive.
The change in length and diameter is negative when the cylinders lose water by osmosis to hypertonic solution.

RISING AND SINKING OF THE DROP

Two sets of the solution are made .one of which is dyed to become coloured .then dip the cylinders of the same size in colour for 45 minutes .Remove the cylinders .with the dropper suck the coloured solution and dip the dropper mid way into the corresponding clear solution and then release a drop .do the same to other solutions.
The drop floats within /spreads (does not sink or rise) in the isotonic solution to the plant tissue.
The drop rises in the denser solution i.e. when coloured solution is less dense than clear solution
The drop sinks in less dense solution i.e. when the coloured solution is denser than clear solution.

The density of the solution is directly proportional to the concentration of the solution i.e. as the concentration increases.
The rate, at which the drop rises, increases with decreasing density of the coloured solution. The rate of sinking of the drop increases within the density of the coloured solution.
When spread the drop spreads, there was no net gain or loss of water by cylinders in the coloured solution, then the concentration of the coloured and clear solutions remain the same.

When the drop sinks, the hypertonic cylinders osmotically absorbed water from the coloured solution making it more concentrated than the corresponding clear one. The drop sinks faster when the cylinder has osmotically lost water to the hypertonic coloured solution making it less concentrated than the corresponding clear solution. The drop rises faster when the cylinder has lost more water to the hypertonic coloured solution making it more less dense (less concentrated) compared to corresponding clear solution.

Solutions of varying concentrations are set .cylinders of same size are made at least 1cm diameter and 6cm length. Immerse one cylinder in each solution. Let the experiment stand for 60minutes .remove the cylinders without losing any drop of the solution. Then measure and record the final volume of the solutions.
The solution whose volume remains the same or closest to the original volume ,has a concentration similar to that of the potato cylinder .such solution also gives a ratio of initial volume to final volume of 1:1or nearest to that.
The solution which increased in the volume osmotically gained water from hypotonic potato cylinder .thus the solution was more concentrated or has lower water potential or has higher osmotic potential than the cylinder.
The solution which reduced in the volume osmotically lost water to the hypertonic cylinder. Thus the solution is less concentrated or has a higher water potential or a lower osmotic pressure or a higher osmotic potential than the potato cylinder.
When arranging solutions in decreasing water potential or osmotic potential, start with ore dilute solution and end with more concentrated solution .this is because a more dilute solution has a higher osmotic potential or water potential.
The cylinders in the solution with osmotic potential are characterized by being hard or turgid or rigid or stiff, longer, swollen or bigger and with a rough texture.
The cylinders in the solution the lowest osmotic potential are characterized by being soft or flabby, shrunken, shorter and with a smooth texture.
The *importance of the above characteristics of the cylinders in different concentration are;*

- The herbaceous plant takes in water by osmosis to become turgid and gain support.
- Turgidity enables plant to store water.
- Flabby nature leads to wilting of plant leaves to reduce water loss.

PERCENTAGE PLASMOLYSIS OF PLANT CELLS

The epidermal strips are immersed in the solutions varying concentration for 20 minutes.
Count the number of plasmolysed cells in every 20 cells .calculate the percentage plasmolysis of the cells in each solution. Then plot a graph of percentage against concentration.
NB.
Sometimes a standard solution (a solution of a known concentration) is provided .this can be used to prepare many solutions of varying concentration but of same volume. This is done by using dilution

method .i.e. .a certain volume of the standard solution is obtained which is then dilute to prepare the required solution.

Follow the formula below.

$M_1V_1 = M_2V_2$ Where M_1 =Concentration of standard solution

V_1 = Volume of a standard solution to be diluted.

M_2 = Concentration of the new solution

V_2 = Volume of the new solution.

***BENDING OF THE HERBACEOUS PLANT STRIPS/* CURLING OF THE STRIPS OF THE PLANT TISSUES**

Obtain along inter node of a young plant stem e.g. commelina. Cut it into four longitudinal strips. Dip one strip into each of the three solutions of known different concentrations.

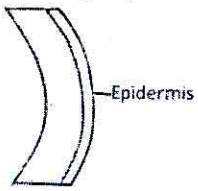
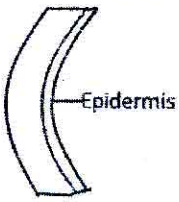
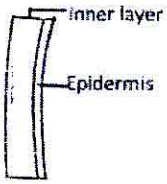
Observe the strips after 20 minutes.

The strip in the dilute solution more than that of the cell sap of the plant tissue, absorbs more water by osmosis into its fleshy inner cells and then bends outwards.

The strip in concentrated solution compared to that of the plant tissue, losses water by osmosis to the solution, its fleshy cells become flaccid and the whole strip bends in wards.

The strip in the isotonic solution (similar concentration) does not curl (bend due to absence of a net loss or gain of water.

Illustration of the bending (curling) of the strips in different concentrations.

In concentrated solution	**In dilute solution**	**Isotonic solution**
Concentrated solution is hypertonic to the cell sap of the strip. Cells on the Inner side of the strip loss more water than the epidermal cells, causing inward bending.  inward bending	Dilute solution is hypotonic to the cell sap of the strip. Cells of the cortex/ inner side of strip therefore gain more water than the epidermis, causing outward bending.  Outward bending	Isotonic Solution has the same solute concentration like that of the cell sap of the strip cells, thus there will be no net movement of water and the strip does not bend.  No bending

Measure the distance between the two bent ends and study how the distance between the two ends varies with varying concentration.

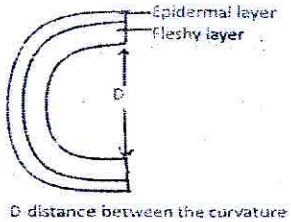
The strip bends in wards when its inner fleshy cells loss water osmotically to a hypertonic solution .due to loss of more water by fleshy inner cells than the epidermal cells, the fleshy cells shrink making the whole strip to bend in wards.

The strip in the solution with the same concentration it remains straight without bending, this is due to no net osmotic gain or loss of water by the strip.

The strip in the hypotonic solution bends out wards with its epidermal layer in wards .this is a result of osmotic gaining of more water by the Fleshy layer, it expands more leading to out ward bending.

When the strips are immersed into solutions of different concentration their degree of curvature increases with increase concentration i.e. the distance between the two ends becomes shorter with increasing concentration.

Study the illustration of the curved strip



If the distance between the two ends is plotted against the concentration of the solutions, a graph showing an inverse proportionality between the distance of the two ends and the concentration of the solutions.

PLANTS AND THEIR EXTERNAL STRUCTURES

DETERMINATION OF MAGNIFICATION OF A MICROSCOPIC DRAWING

View the specimen using a given objective lens (magnification power) like medium power view and draw the specimen. Remove the specimen and place a transparent meter rule to measure the field of view Record the size of the field of view in millimeter (mm). The size of the field is equivalent to the actual size of the specimen .convert the size of the field of view into micrometer (*μm*),***(1mm=1000 μm).*** Measure the size of drawing in millimeter and convert it into micrometer.

The magnification of the drawing = $\frac{\textit{size of the drawing (μm)}}{\textit{Actual size of the specimen (μm)}}$

If a part of the drawing is drawn, calculate the actual size of the part drawn (it can be one cell) and record it in micrometer .then work out the magnification of the drawn part as shown for the whole specimen above.

For example .if 10 cells are viewed in a field of view of 2mm, the actual size (length) of the one cell drawn is.

$$\frac{2\text{mm}}{10 \text{ cells}} = 0.2\text{mm}$$

Thus the actual size (length) of **ONE** cell is **0.2mm x 1000 =200μm**

Suppose the length of one cell drawn is 4mm, the length of the drawn cell in micrometer is

4 x 1000 =4000μm

Thus the magnification of the drawing = $\frac{\text{The length of the drawing (μm)}}{\text{Actual length of a cell (μm)}}$

$$= \frac{4000\ \mu\text{m}}{200\mu\text{m}}$$

= X20

The common specimens used under this section are;

- Plant organisms e.g. Rhizopus (bread moulds) Algae (spirogyra), Bryophytes (moss) and other plants.
- Plant structures like leaves, stems, and roots, flowers and seeds .when studying plant structures, consider the external features.

KINGDOM: FUNGI

Reason: *Body made up of (fine) filaments/hyphae*

Phylum: *Zygomycota*

Reasons

- *Sporangiophore/vertical hyphae/stalk with round sporangium*
- *Network of branching hyphae/mycelium/stolon/horizontal hyphae*

DESCRIPTION OF RHIZOPUS

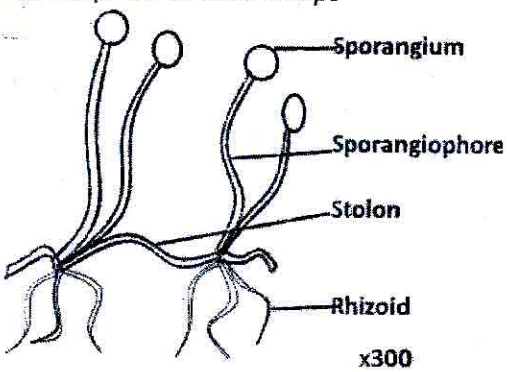
RHIZOPUS (BREAD MOULD)

Body made up of mesh work/network; of fine/thin slender; long/elongated filaments/hyphae/fibres; some upright/vertical/sporangiophore; others horizontal/stolon; vertical hyphae/upright/sporangiophore with spherical/round /swollen/large structure/sporangia; at their tips;

Classification of Rhizopus species

Kingdom	***Fungi***
Phylum	***Zygomycota***
Class	***Zygomycetes/phycomycetes***
Order	***Zygomycetales/murals***
Genus	***rhizopus, mucor***

Drawing of a portion of mould observed under Medium power of a microscope



STRUCTURAL FEATURES OF RHIZOPUS

It consists of a mass on thin branching, threadlike structures known as mycelium, *long/enlongated,slender/thin threadlike* vertical filament/hyphae called **sporangiophore**, terminating into a *spherical/round, smooth/rough,* black/brown called **sporangium**/spore case.

Mycelium

It consists of stolon or linking hyphae/horizontal hyphae or filament and rooting hyphae the rhizoids. **Stolon** is long, slender/ thin/fine, branched and forms a net work of hyphae called **mycelium.** Mycelium has a large surface area for support.

Rhizoids are numerous, thin, pointed and slender, they are

- Thin/pointed to easily penetrate the substratum.
- Many numerous to increase surface area for absorbing nutrients.
- To easily absorb nutrients easily by reducing diffusion distance.

Sporangium (spore capsule)

It is ball shaped or bulbous or spherical, swollen, and dull coloured or black.

Rhizopus is found in moist places to avoid desiccation. It is smooth, thus it can easily lose water leading to desiccation if exposed to high temperatures.
The nutrition of Rhizopus is **heterotrophic** due to lack of chlorophyll.

Adaptations of rhizopus to survive in its environment

- *Long sporangiophore/vertical/hyphae to expose sporangium for spore dispersal*
- *Thin/slender sporangiophore for flexibility to increase chances of spore dispersal*
- *Large/swollen sporangium to store/produce many spores to increase chances of reproduction/propagation*
- *Thin/pointed tip of rhizoids for easy penetration into substratum*
- *Many stolons for faster colonization/propagation*
- *Numerous sporangia to produce large amounts of spores;*
- *Many horizontal filaments/hyphae/stolons to spread out for easy colonization;/nutrition*
- *Numerous rhizoids for anchorage/food absorption*

Limitations that the rhizopus face in its terrestrial environment

- *Thin so easy loss of water*
- *Lacks protective structures against water loss*

Economic importance

- They enhance recycling of nutrients in an ecosystem by decomposing dead organic matter.
- Some species of mucor produce enzymes that ferment sugar and so used in production of alcohol /breweries.

Phylum: Basidiomycota e.g mushroom

- Has septate hyphae
- *Has large cap/pileus; with numerous gills/lamella*
- *Has a stalk/stipe; body made up of fine filaments/hyphae, with rooting hyphae/rhizomorpus/rhizoids; sheet like structures under the cap/lamella;*

Adaptations of mushroom

- *At the ends of these hyphae there are swellings/ sporangia which contain spores for propagation*
- ***Numerous filaments/a** Net work of hyphae for anchorage*
- *Numerous rhizoids to increase surface area for absorption of food nutrients*
- *Thin rhizoids reducing the diffusion distance during absorption of food and easy penetration of the substratum.*
- *Thick and short stalk for firm support of the basidium*
- *Thick outer cuticle on the basidium to prevent dessication*
- *Numerous membranes/ gills on the lower surface of the basidium increasing surface area for spore production*
- *Membranes on the lower surface of the basidium to avoid dessication.*

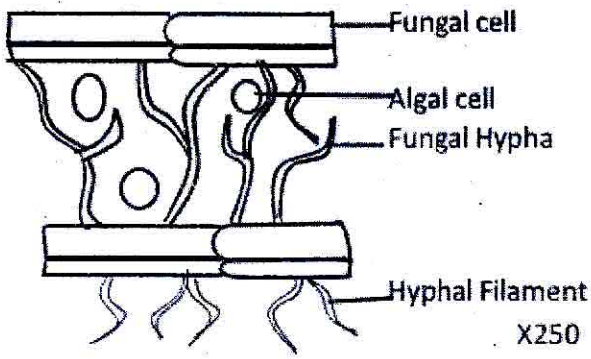
LICHENS

Crustose/crust-like /flattened body; undifferentiated body; has hyphae/filaments/rhizoids; lobed;/regulary shaped

Adaptations lichens

1. Numerous lobules which can break off and develop into a new lichen dispersing the alga and fungus together
2 Numerous soredia containing spores for propagation
3. **Hyphal** filaments for support on to the substratum and for absorption of water/ mineral salts.
4. **Broad** to increase surface area for trapping a lot of solar energy for the alga to carry out photosynthesis
5. Thin to reduce on the diffusion distance of the gases during gaseous exchange.

Drawing of Lichen observed under medium power



ADAPTATIONS

1. Green round algal cells for absorption of sunlight for photosynthesis
2. Numerous fungal hyphae for protection of the algal cells from drying out
3. Elongated fungal cells to offer protection of the algal cells
4. Numerous hyphal filaments for anchorage and absorption of water

MOSSES

The moss plant is found in the main plant group (phylum) called **Bryophyta** due to possession of a

- *Spirally arranged leaf like structures/simple leaves /false leaves*
- *Body differentiated into simple leaves and stem attached to gametophyte anchored by rhizoids*
- *Spore bearing capsule/sporangium at the end of the seta/stalk*

Classification

Kingdom	***Plantae***
Phylum	***Bryophyta***
Class	***Musci***
Genus	***Funaria***

Class: ***Musci***
Reason:-

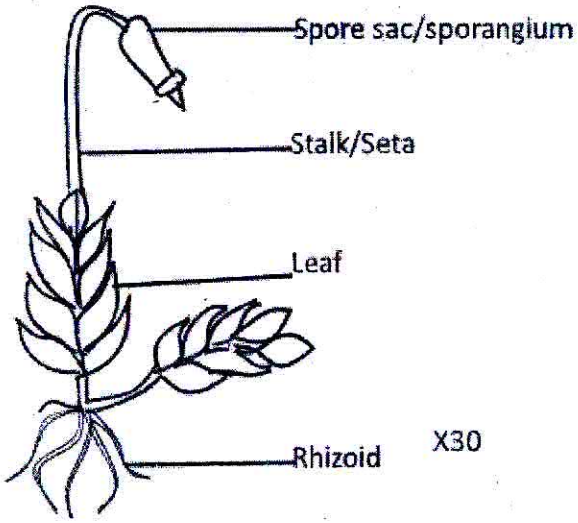
- *Small sized; stem with spirally arranged leaf-like structures;*
- *Presence of thin rhizoids;*
- *Prominent spore bearing capsule;*

Adaptations that enables it to survive in its habitat

- *It has numerous rhizoids for anchorage and absorption of water from substratum*
- *It has a large /swollen spore capsule to produce numerous spores allow quick colonization of sporophyte on the land.*
- *Has long seta/stalk to raise the spore capsule high for easy dispersal of spores*
- *Has spirally leaves to increase surface area/exposure to sunlight for photosynthesis.*
- *Numerous leaves to increase surface area for light absorption*

- *Thin rhizoids to ease absorption of nutrients*
- *Large/swollen sporangium to store many spores*
- *Erect stem to expose leaves for photosynthesis*
- *Erect/upright seta to expose sporangium for easy dispersal of spores*
- *Thin seta for easy swing for dispersal of spores*

Drawing of a moss PLANT



HABITAT

Moist/damp/damp shaded terrestrial soil/tree trunks/walls of houses/buildings

Moss plant is adapted to surviving in moist areas of land due to possession of swallow rhizoids, very short stalk and small leaves.

STRUCTURAL CHARACTERISTICS

Sporophyte is attached to the leafy gametophyte

It has Sessile/unstalked ovate, small sized, net veined, hairy, pale green "leaves" which are spirally arranged on a simple stem.

Economic importance

- Their decomposition increases soil humus content/fertility.
- They add oxygen to the atmosphere and remove carbon dioxide from it.

FERNS

Classification

Kingdom	***Plantae***
Phylum	**Filicinophyta/pteridophyta**
Class	**Filicineae**
Order	**Filicales**
Genus	**Dryopteris**

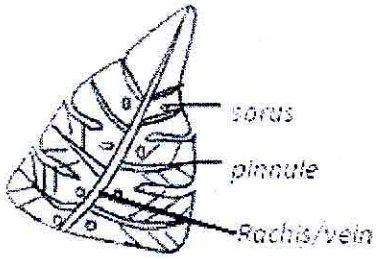
PHYLUM: Filicinophyta/pteridophyta

Reasons

- Possession of relatively large leaves
- Sori underside/lower surface of the leaflets
- Numerous adventitious roots.

To describe the structure

- Differentiated into adventitious roots/rhizome; leaves/fronds; lamina divided into leaflets/pinna with pinnules;
- Lower surface has sori/group of sporangia;
- It has large leaves (fronds) arising from a thin rhizome. The rhizome bears a mass of fibrous adventitious roots.



Characteristics of fern plant

- It bears relatively large leaves
- It bears adventitious roots
- It bears numerous sori underside the leaflets
- It has along hard leaf stalks with vascular bundles

Adaptations of the fern plant to its environment

- It has relatively large leaves for losing excess water and absorbing more light for photosynthesis
- It has long adventitious roots for anchorages and for absorbing water
- It has numerous sori for producing many spores increasing chances of reproduction
- It has long leaf stalk to raise the spore case/sori high for easy dispersal of spores
- It has buds for vegetative reproduction

The leaves are compound, each consisting of the main axis (rachis)/have a thick base or petiole bearing leaflets called pinnae, each of which is subdivided into pinnules.
The lower surface of the pinnae bears some clusters of sporangia.

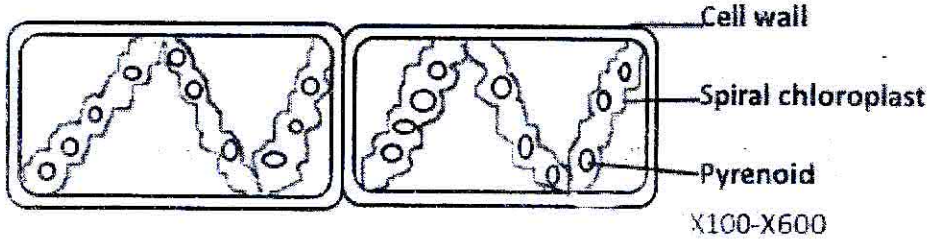
KINGDOM: PROTOCTISTA **EXAMPLE: SPIROGYRA**

Kingdom	**Protoctista**	• *Unicellular/single celled* • *Numerous identical cells*
Phylum	**Chlorophyta**	• *Spiral chloroplast* • *Filamentous/thallus/ filamentous body* • *Septate filaments/Septate cells/cells joined end to end*
Class	**Chlorophyceae**	
Order	**zygnematales/conjugales**	
Genus	**Spirogyra**	

Structural characteristics of spirogyra

- Each filament is a chain of rectangular cells, joined end to end/separated by end walls.i.e Its filaments are separate lengthwise.
- It has thick cell wall.
- It is long, unbranched and filamentous.
- It has long spiral shaped chloroplast.
- It has numerous small circular pyrenoids.
- It has a large vacuole.
- It has thin cytoplasm.

Drawing of two adjacent cells of specimen P as seen under medium power of a microscope



X100-X600

Adaptations of spirogyra to survive in its environment

- *Long filamentous for increased surface area for absorbing sun light for photosynthesis.*
- *The cells are joined end to end to ease fragmentation or sexual reproduction and for flexibility.*
- *It has long spiral chloroplast to increase surface area trapping sun light for photosynthesis.*
- *It is a thin filament for easy floating on water.*
- *It has numerous pyrenoids to store much food.*
- *It has thick cell wall for protection/preventing bursting.*
- *Septate/segmented for easy fragmentation/propagation*
- *Filamentous for easy diffusion of nutrients/materials*

Economic importance.

- Spirogyra / algae are the primary producers in fresh water ecosystems.
- They release oxygen into the water for use by aquatic organisms.

PHYLUM: ANGIOSPERMOPHYTA/TRACHEOPHYTA/SPERMATOPHYTA (higher plants)

These are seed bearing plant with the following characteristics

- *Body differentiated into roots, stems and leaves*
- *Presence of flowers*
- *Presence of vascular bundles*

Angiospermophyta/Angiospermae

They are sub-divided into two classes

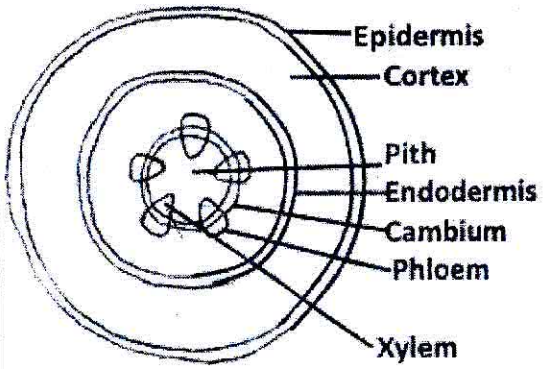
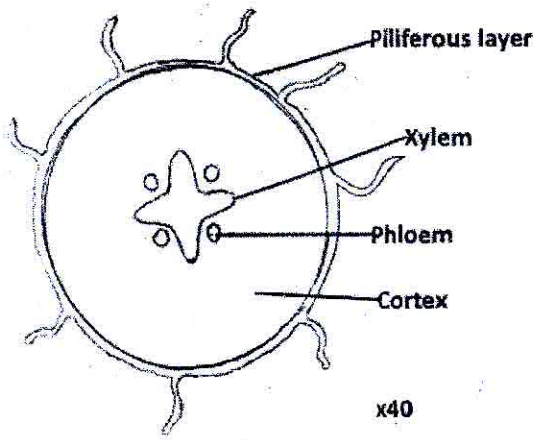
Class: Monocotyledoneae

Class: Dicotyledoneae

Reasons basing on the observable features

Monocotyledoneae	**Dicotyledoneae**
Parallel veined leaves.	• *Has leaves with net work veins*
Leaf sheath	• *Has Leaves attached to stem by solid long stalk*
Fibrous root system.	• *Presence of one main root with numerous lateral branches which is tapering and long*
Narrow and elongated leaves	• *Has Leaves with broad/large lamina*
Vascular bundles distributed randomly distributed in the stem.	• Vascular bundles radically arranged on the ring of the cambium.
	• Has a central pith and a clear cortex
	• *Star arrangement of xylem tissues in whose arms are the phloem tissue*

THE STEM AND ROOT STRUCTURE

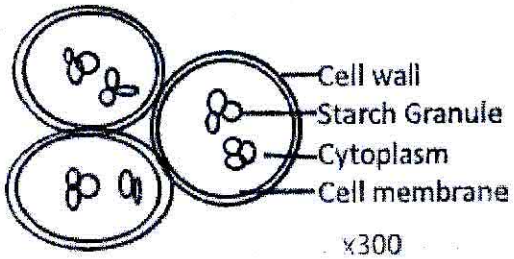
Drawing of a cross section of a Dicotyledonous stem	**Drawing of an internal structure of a dicotyledonous root**
	

These include; Parenchyma tissue, Sclerenchyma tissue, Collenchyma tissue **and** Epidermal tissue

Parenchyma tissue is characterized by having the following features.

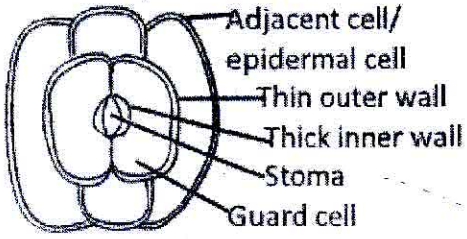
- It is made of spherical or round cells.
- Its cells have thin cytoplasm.
- Its cells have large food vacuole.
- Its cells area closely packed.
- Its cells have starch granules.
- Its cell has thin cell wall.

Drawing of three parenchyma cells



x300

Drawing of two Guard cells and Adjacent cells



Functions of parenchyma cell

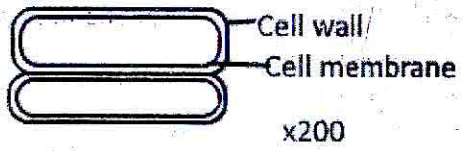
- It is used for storage of food due to possession of starch granules and large food vacuole.
- It is used for support when turgid due to being closely packed.
-

Collenchyma tissue

It is characterized by having;

- Cell with thick cell wall
- Polygonal (rectangular)cells
- Closely packed cells

Drawing of Two collenchyma cells



x200

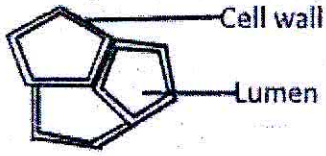
Collenchyma tissue is used for support due to its closely packed cells with a thick **cell wall.**

SCLERENCHYMA TISSUE

This tissue is characterized by having;

- Thick walled cells
- Hollow and elongated cells
- Cells with no cytoplasm
- Cells with narrow lumen
- Lignified cell wall.
- Polygonal cell tissue

Drawing of sclerenchyma Tissue



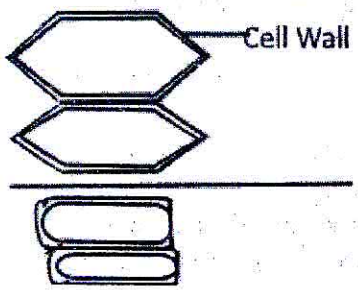
Functions of sclerenchyma tissue

- It is used for support due to possession of a very thick lignified cell wall.
- It cells are hollow for easy flow of materials.
- Its cells have a narrow lumen to facilitate capillarity

Epidermal cells

- Its cells are polygonal or rectangular
- It is thin and thus transparent.
- It cells are closely packed.
- They are Elongated
- Have thick cell wall

Drawing of Epidermal cells



Functions of epidermal tissue

- They are closely packed to protect inner tissue from physical injuries.
- Have thick cell wall for protection
- Elongated cells offer a large surface for protection.

NB

- When a cross section of an angiosperm stem is stained with an acidified pyloroglucinol, lignin in the tissue s of sclerenchyma and xylem stains red or pink.
- When asked to draw a tissue plan of section observed under a microscope, only draw tissue lay out without showing details, i.e. tissue plan of the description of the dicotyledonous stem.

INSECTS

Insects belong to class insect of kingdom **animalia** of phylum **arthropoda.**
About seventy five percent of all known species of animals are insects. They are found in various habitats all over this planet, earth. They are in a great variety but share some general characteristics. Some are beneficial to man and others are harmful to man.
Arthropods are divided into 5 classes i.e. Insecta

Arachnida, crustacea, Chilopoda and Diplopoda

These are animals in phylum **arthropoda** with the following distinguishing **characteristics.**

- Have exoskeleton
- Have jointed legs
- Have segmented body.

Classification of selected arthropods is shown in the table below.

A table of classification for selected arthropods

Arthropods	phylum	class	Order
Bee/wasps	Arthropoda	Insecta	Hymenoptera
Soldier termites	Arthropoda	Insecta	Isoptera
Housefly/mosquitoes	Arthropoda	Insecta	Dipteral
Tick	Arthropoda	Arachnida	Acarina
Cockroach	Arthropoda	Insecta	Dictyoptera
Grasshoppers	Arthropoda	Insecta	Orthoptera
Spider	Arthropoda	Arachnida	
Sugar ant	Arthropoda	Insecta	Isoptera
Butter flies/moths	Arthropoda	Insecta	Lepidoptera
Beetles/weavils	Arthropoda	Insecta	Coleoptera

Kingdom: ***Animalia*** (all the specimens)
Reasons: Presence of:

- sensory structures e.g. Eyes
- Mouth for feeding
- Structures for locomotion e.g.limbs

Class: ***Insecta*** (housefly, worker bee, worker termite, grasshopper)
Reasons

- Three main body parts.
- One pair of antennae.
- Three pairs of limbs/appendages.
- Three thoracic segments (prothorax, mesothorax and metathorax)

Class: Arachnida(tick)
Reasons

- Two main body parts i.e. head fused with thorax, and abdomen
- Four pairs of limbs.
- Lack antennae

	Housefly	Worker bee	Worker termite	Grasshopper	Tick
Order :	Diptera	Hymenoptera	Isoptera	Orthopteran	Acarina
Diet: **Reason:**	Fluids e.g. faeces -Proboscis is expanded at the tip to suck fluids.	Fluids e.g. nectar -Glossa is narrow at tip for sucking	Solid substances e.g. wood -Mandibles are sharp for cutting	Solid substances e.g. grass -Mandibles are sharp for cutting	Fluids e.g. blood -Chericerae have hooks for piercing animals
Ecological role, and how suited	Transmission of germs that cause diseases. -Hairy body enables attachment of germs	Pollination -Pollen baskets on hind legs for attachment of pollen	Destruction of wood -Hard mandibles for cutting wood	Destruction of vegetation -Sharp mandibles for cutting grass	Parasite on mammals -Chelicerae have hooks for piercing skin of mammals
Habitat:	-Pit latrines -Rotting garbage	-Bee hive	- Termitarium **OR** -Termite mound	Green grass	Bodies of mammals

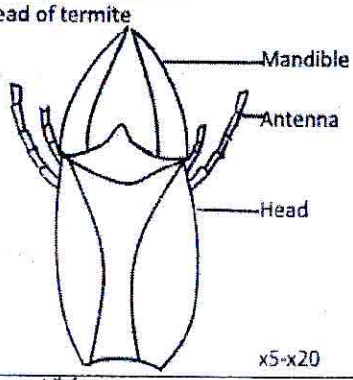
DESCRIPTION OF BODY PARTS

	Housefly	Worker bee	Worker termite	Grasshopper	Tick
Head – general	ovate/Triangular shaped -Hairy	-Triangular shaped -Hairy	-Rectangular, sooth dorsal surface, brightly coloured, dorsal-ventrally flat.	-Large	Fused with thorax and abdomen
One eye:	Large, Dull coloured, oval-shaped, dorso-laterally positioned.	Large, Dull coloured, comma-shaped, dorso-laterally position.	No eyes	Large, Dull coloured, smooth, protrude, oval-shaped, dorso-laterally positioned.	Small
	Housefly	**Worker bee**	**Worker termite**	**Grasshopper**	**Tick**
Antenna:	Short, hairy, segmented, with bristles.	Short, hairy, segmented, bent	Short, not hairy, segmented, blunt ending	Short, thin, pointed, jointed	No antenna
Mouth parts:	-Proboscis is expanded at the tip. -Large labium -Maxillary palp short, hairy.	Hairy, proboscis is **pointed** and **curved** at the end, mandibles are two, small. blunt for moulding pollen/wax	Mandibles are 2, short, pointed, strong, curved, sharp. Labial palps are 2, jointed, short, hairy	Mandibles are two, hard, large, serrated. Maxillae are two, hairy Labrum is one, thin, hard. Labium is one, hairy.	2 palps, 2 chelicerae, Hypostome is 1, barbed, needle-like.

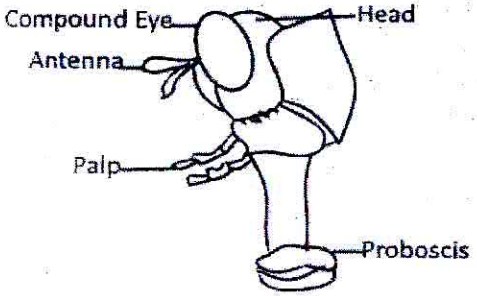
Thorax:	3 segments, hairy, striped, Halteres are 2, short, attached on the third thoracic segment.	3 segments, hairy, segmented,	3 segments	Thick, box-like, consists of 3 fused segments.	Fused with head and abdomen
Wings	2, transparent, network veined	Four, flattened, membranous. Inner wings have hooks on the top edge	Wingless / no wings.	Are 4, forewings two, leathery, narrow, veined. Inner wings two, thin/membranous, broad & veined	No wings
Limbs:	6, hairy, jointed, have glandular pad between the 2 claws. Hind limbs are long	Six, jointed, hairy legs. Hind leg long, has pollen basket on tibia, pollen brush	3 pairs, jointed, smooth, almost equal size.	Has 6 legs, jointed for flexibility, pointed spined for protection. Hind legs are long, have **large femur** forcreating a lift force.have curved claws for gripping	Eight, jointed, hairy
Abdomen:	Segmented, hairy, pointed posteriorly, short	Segmented, narrow, has a sting at the posterior end.	Segmented, smooth.	Segmented, terminal segment has **cerci**	Fused with thorax and head
specimen	**Butter fly**	**Sugar ant**	**cockroach**	**Millipede**	**Weevil /**Beetles
Head region	Two long club-shaped/knobbed **antennae** Two large **compound eyes** Two long **maxillary palps** Long coiled **proboscis**	Two, short antennae Two small sized compound eyes Two serrated mandibles, Two long segmented mandibles Two short segmented labial palps	Has Two, long, thin, tapering **antennae** Has two large **compound eyes** Two, large, serrated **mandibles** Two long, segmented **maxillary palps,** two segmented labial palps curved **labrum**	Sharp mandibles, pair of long segmented antennae Has eyes/oceli Has curved labrum	Has a rostrum/snout/boring mouth pats
Thorax Wings		No wings	4 viened,wings Outer wing thick, long & narrow, Inner wing thin & broad/large	No wings	Two pairs Hard/ thick outer wings; longer thin inner wings

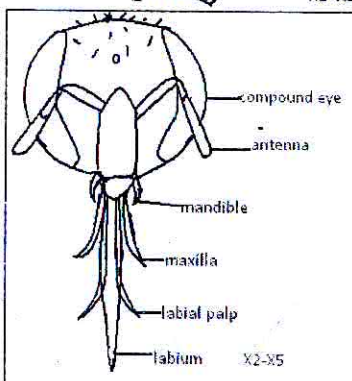
Limbs	6 jointed legs with curved claws and sticky glandular pad	6 jointed legs with curved claws and sticky glandular pad	Long with pointed spines, curved claws, large sticky arolium	Many jointed limbs with curved claws	6 jointed legs with claws and glandular pad
Abdomen		Tapering posteriorly	Flattened and has a pair of ssgmented hairy anal cerci		Tapering posteriorly

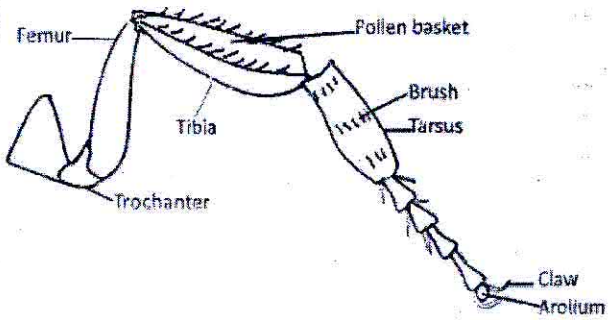
Drawing of Ventral side of the head of termite



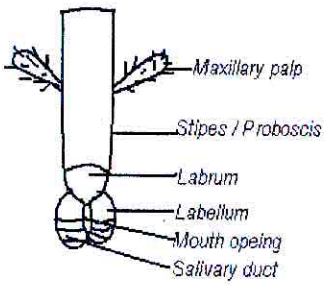
Lateral view of a house fly's head



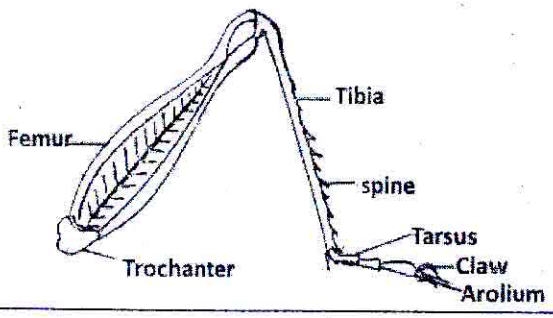




Anterior veiw of house fly proboscis



Drawing of the hind limb of grass hopper



THE EARTHWORM It is found in phylum **annelida** **Reasons** • has sharp/ bristle like chaetae in each segment,	**Habitat:** damp /decomposing moist organic matter/mud soils Reasons • Segmented body for flexibility during movement

• has metameric segmentation • presence of septa • soft cuticle, • cylindrical body. **Class: oligochaeta** Reasons • Has two pairs of chaetae in each segment • Presence of clitellum It feeds on **decaying matter of both plants and** animals found in the soils. It is adapted to this feeding habit due to possession of; • The mouth for swallowing food. • Pointed ends for borrowing into the mud in searching for food. • The anus foe passing out egesta containing the soil. • The moist soft cuticle for borrowing into the mud for food	• Has Pointed/tapering ends for penetrating the soil/easy burrowing • Has chaetae for locomotion/Numerous chaetae for gripping onto mud • Stream lined body for easy movement in damp soils • Cylindrical body for easy movement in soil • Has Moist soft cuticle for gaseous exchange • Long body for easy movement in burrows and to increase surface area for gaseous exchange • Mouth for swallowing food in moist soil(decaying matter) • Clitellum for carrying the eggs • Anus for passing out egesta which even contains soil s
MILLIPEDE **Description** The long body is cylindrical, segmented, covered by hard cuticles, bears two pairs jointed limbs on each segmented and dark coloured .the body segmented for flexibility, hard cuticles for physical protection .numerous limbs for locomotion, and dark cuticle for camouflage It is commonly found in the litter of the forest and the garden which may moist . The millipede is able to feed on the litter /plant materials due to possession of hard shard mandibles used for cutting the litter. The **importance of the millipedes in** the environment • It causes decomposition as it feeds on the litter. • Its sticky egesta blinds soil particles hence improving soil structure • It improves soil aeration as it burrows • It improves soil drainage as it burrows • It adds humus to soils when it dies and decomposes • It is the source of food to other animals.	**adaptations to living in this environment** • It has sharp and hard mandibles for cutting food (litter) • It has ocelli for seeing • It has a pair antennae for sensitivity • It has hard cuticle (exoskeleton) for physical protection • It has jointed limbs for flexibility. • Its body is segmented for flexibility during locomotion • Its exoskeleton is dark coloured for camouflage. • It has numerous limbs for fast locomotion • It has cylindrical body for easy burrowing

Importance of the earthworm to the environment

- The pointed ends makes it able to borrow into the soil in order to improve soil aeration ,soil drainage ,mix up the soils and soften up the soils foe easy root penetration
- It is a source of food to other animal

Similarities between millipede and earthworm

Both earth worm and millipede have a mouth, anus and cuticles, structure for locomotion, segmented body cylindrical body, and long body

Differences between earth worm and millipede

Earthworm	Millipede
Has soft cuticles	Has hard cuticle
Has no eye	Has ocelli
Has no distinct head	**Has** distinct head
Has chaetae	Has true limbs
Has no mandibles	Has mandibles
Has clitelllum	Has no clitellum
Has no antennae	Has antennae

TICK

Class: Arichnida

Body

- *Four pairs of limbs/legs*
- *Body divided into two main body parts i.e Cephalo-thorax which is thick broad and has hairs and abdomen*

Eyes: *NO compound eyes*

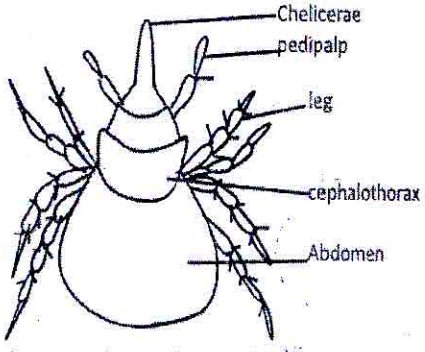
Antennae: *no antennae*

Mouth parts: *segmented and end in pincers/pointed/tapering tip*

***Adaptations of tick* to its mode of life/as ectoparasite**

- Legs with spikes/claws for firm attachment
- Tough,slipperly exoskeleton for protection against mechanical injury
- Dull/dark coloured for camouflage
- Hooked/curved mouth part for firm attachment
- Flattened body to fit on the body of the host for protection
- Has sharp/pointed mouth parts for piercing
- Has sharp sucking mouth parts for sucking blood/food
- Sharp claws for clinging onto the host
- Has chelicerae for penetrating/piercing the skin of the host

Drawing of dorsal view of a tick



FLOWERS

A flower is the reproductive organ of the plant. it consists of floral parts arranged in whorls or rings.
These are:

- The sepals together forming the *calyx*
- The petals together forming the *corolla*
- The stamen together forming the *androecium* which consists of anther and filament.
- The carpels together forming the *gynoecium* or pistil which consists of stigma, style and ovary.

These floral whorls are usually attached on a receptacle at the end of the flower stalk (pedicel)
Some flowers have an extra whorl of sepal like structures external to the calyx called **epicalyx.**
The reproductive parts i.e. stamens (androecium) and carpels (gynoecium) are **the essential** parts of a flower.
All the other parts e.g. sepals, calyx and corolla are referred to **as non-essential** parts.
In flowers of most monocotyledonous plants, the sepals and petals are **undistinguishable** and are collectively known as **perianth.**
Pedicel is the flower stalk and **Peduncle** is the inflorescence stalk.
Corolla tube is a tube formed by the union of lower parts of the petals e.g. in morning glory flower.
Petaloid – (describes coloured sepals (calyx))

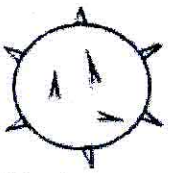
TERMS USED IN FLOWER DESCRIPTION

Actinomorphic (regular) flower- Is a flower possessing radial symmetry and capable of division into symmetrical halves by any longitudinal plane passing through the axis.
This is in a case where a flower can be vertically split through the center in any plane and all the sections produced have identical parts.
Zygomorphic (irregular) flower- Is a flower possessing bilateral symmetry and capable of division into symmetrical halves by only one longitudinal plane passing through the axis
This is in a case where a flower can be split into two identical sections in one plane only e.g. bean flower
Hermaphrodite or bisexual flower:-Is a flower possessing both male (stamens) and female (carpels) parts.
Unisexual flower-Is a flower possessing one sexual part i.e. either female or male. If such a flower has only stamens, it is referred to as *staminate*. If it has only carpels (pistil) it is referred to as *pistillate*.
Dioecious plant-Is a plant in which staminate and pistillate flowers are borne on separate plants e.g. pawpaw.
Monoecious plant-Is a plant which has both staminate and pistillate flowers e.g. maize.

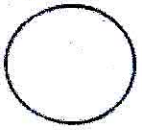
The gynoecium .The gynoecium/ovary is said to be **monocarpous** if it consists of one carpel e.g. cassia. **Apocarpous** if it consists of *more than one free* carpels and **syncarpous if** it consists of *several fused carpels.*

A drawing showing the structure of a pollen grain (surface view) under medium power of a microscope for:.

Pollen grain of insect pollinated flower



Pollen grain of wind pollinated flower



Adaptations

The pollen grain from a wind pollinated flower is

- *small;* which makes it light; so that it can be easily carried off/blown by wind,
- The *smooth surface* reduces air resistance from one flower to another.

The pollen grain from an insect pollinated flower is

- *Large,* to increase the surface area for attachment onto the insect's body,
- The *spiny surface* is to stick on the body of an insect /stigma.

FLORAL FORMULA

This is a conventional formula showing the number of floral structure and nature of the flower and its structure.

The following symbols are used in floral formula.

A floral formula is a method of expressing the number and arrangement of the four whorls of a flower using standard symbols.ie.

⊕ = actinomorphic

⊥ = zygomorphic

K = Calyx

C = Corolla

A = Androecium

G = Gynoecium

P = perianth (petal/C and sepal/K are not clearly distinguishable/indistinguishable)

A number following the whorl abbreviation=number of parts in the whorl .e.g. K5. Same number in brackets = parts joined e.g. K (5)

K5 = five free sepals

K (5) = five fused sepals

$\overline{G\,1}$ = flower has one inferior carpel

$\underline{G\,1}$ = flower has one superior carpel.

⌒ = A link between two whorl symbols, one inserted on the other.eg

$C_{(5)}$ A_5

A∞ =numerous stamens (usually more than 12)

♀ = pistillate flower

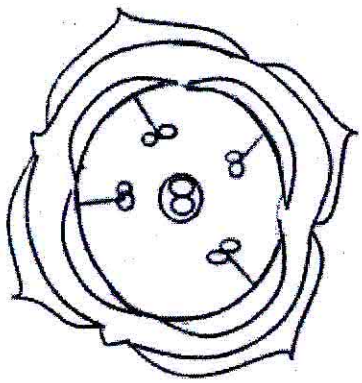
♂ =staminate flower

⚥ = Bisexual flower

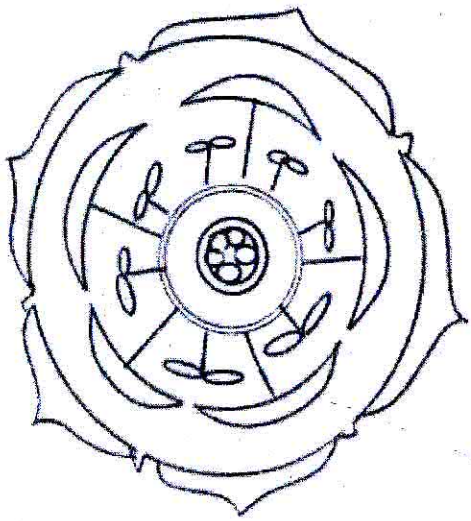
○ =position of main axis

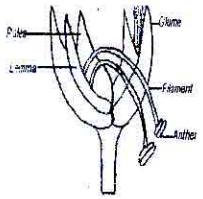
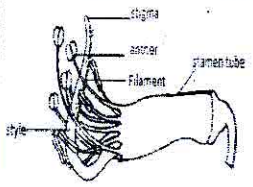
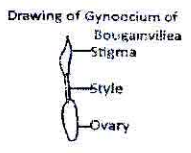
$P\ (_3+_3)$ = two undifferentiated whorls which are united.

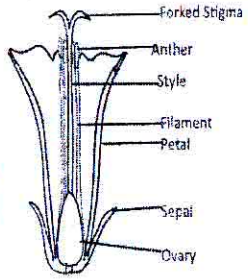
Floral diagram of Latana camara

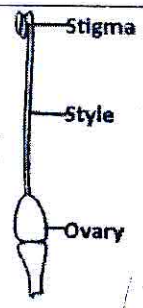
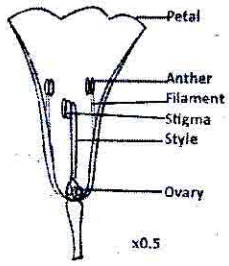
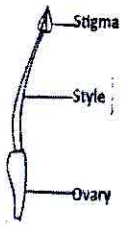


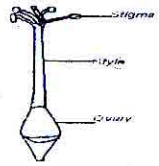
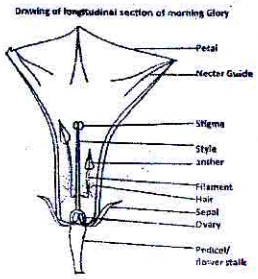
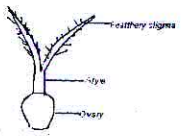
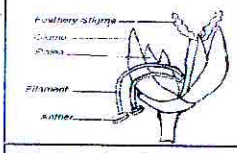
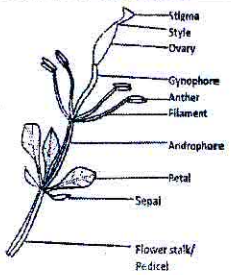
Floral diagam of Hibiscus flower

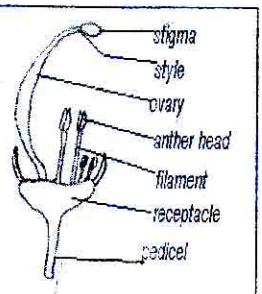
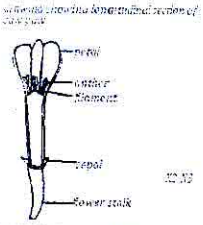
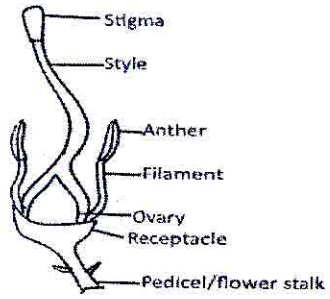
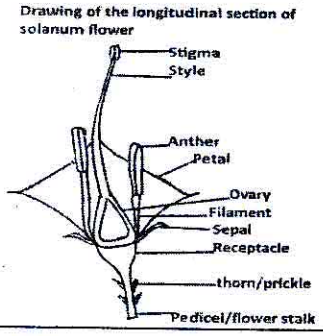


Specimen	Gynoecium	Androecium	Features of Petal s and sepals
K-Maize flower			
	**No gynoecium**	*Three free stamen; free filaments; anthers free; long; slender pendulous smooth large bilobed brightly coloured and loosely attached to filament which are thin, long, flexible and slender*	*Dull coloured ;bisexual/staminate; anthers hanging outside the bracts; inflorescence/raceme/flowers are borne in pairs/spikelets; pendulous stamens;zygomorphic;*
Maize Inflorescence	*It consists of a main axis called **peduncles** which branches into many branches that alternately attached to the peduncles to expose the florets for easy pollination. Each branch bears numerous and paired spikelets which is also alternately attached to the branches .The spikelets in the pair .one is stalked/asessile and the other is sessile/unstalked.* *The spikelets (florets) are alternatively attached to the peduncles and irregular. Each spikelets bears two florets which are covered by bracts. The outer bracts are called **glume** and are hairy, hard, tough and curved or boat shaped, the inner bracts called **Palea** are membranous or thin, smooth, curved in wards and occur in pairs .both inner and outer bracts are parallel veined and dark coloured.*		
L-Crotolaria	*One carpel; stigma long/flattened; hairy; short style ;superior long curved smooth ovary*	*10 stamens ,nine fused into stamen tube; which are grooved; curved and long with free short filaments, anthers bilobed; round; elongated; brightly coloured*	
	Bisexual ;irregular/zygomorphic; five calyx ;not of same size/two big/large ones; corolla-five petals; two fused keel petals/3 free ones ;veined smooth and thin petals *Androecium –ten stamen ;9 fused and one free; stamen part of the filaments fused (9 fused) to form a stamen tube.long filament for the single stamen and short filaments for the 9 stamens.* *Two types of anther/7 elongated rounded and shorten* *Monocarpous pistil; very short style and hairy in crotolaria*		
M -bougainvillea	*Each floret has a pistil with a Elongated; Superior; ovary with short ;thin; style and elongated ;hairy stigma;*	*Florets have eight, Long; thin/slender; free; smooth; filaments and bilobed ;round/circular anthers;*	

inflorescence	*It consists of three asessile, bisexual, and zygomorphic florets all attached at the end of the peduncle. Each floret is attached on inner upper surface along the midrib of the bract. The pedicel of the floret is fused with the midrib of the bract which is bright coloured, large and veined.Each floret has perianth which is dull coloured and fused into funnel tube.**Bracts;** Large /broad; veined; thin; smooth; tapering towards the apex*		
N-commelina	*Each Florets has syncarpous with stigma trilobed ;hairy attached on relatively long style thin and slender and brightly coloured ;superior ovary and*	*Free stamen consisting of brightly coloured;bilobed;elongated anthers that are supported by long, thin;hairy middle way and flexible filament.*	
An inflorescence	*It has one or few florets on the peduncle which are a sessile (stalked).Each floret has a single, curved, hairy, dull coloured and parallel veined spathe (petal like bract).Each Floret is stalked; bisexual; irregular /zygomorphic.; have three,broad;veined,thin smooth;curved free brightly coloured petals and calyx three; tapering veined; thin and hairy;*		
P- bidens pilosa	*Pistil with long/elongated inferior ovary and two/forked fused; hairy; stigma*	*. It has five stamens with fused, bilobed; elongated/long anthers and short; filaments; with regular symmetry.*	
An inflorescence Drawing of the Tubular floret of Bidens Pilosa  	*It has numerous sessile florets which are attached onto a flattened (cup shaped) and expanded apex of the peduncle surrounded by a calyx - like involucres of bracts.* *Two types of floret occur, both sessile with fused corolla, free and spiny calyx and an inferior ovary with one ovule attached at the base of the fruit.* *The **numerous, sessile inner florets called the disc** or tubular florets are arranged in the circular pattern around the centre and closely packed.* *The disc or tubular floret are bisexual, Actinomorphic and consists of five fused petals which form a tube hence the name tubular floret. Its petals have many corolla projections.* *It has five stamens with fused, bilobed, and elongated anthers and short filaments, Pistil has long forked stigma.* *The ray/outer florets are called **ligulate floret in** which the corolla tube is extended and has no stamens and pistil (is sterile.) and are covered by numerous overlapping and dull coloured bracts making the involucres.* *'The ray (ligulate) florets are zygomorphic and found at the peripheral of the expanded apex of peduncle. It consists of broad/open petals at the apex which are tubular at the base.*		

<table>
<tr><td>Lantana camara</td><td>The florets have a syncarpous pistil that consists of bilobed/bilocular/bicarpel; knob-like; obliquely attached stigma to broad base; superior; ovary by a short; thin; style.</td><td>Four Stamens with large; bilobed; elongated; ovoid shaped anthers attached to a short; thin; fused with petals filaments.</td><td> 
</td></tr>
<tr><td>Inflorescence of lantana
 
</td><td colspan="3">The inflorescence consists of the thorny main axis/peduncle from which <u>numerous</u>; sessile/unstalked; bisexual; zygomorphic; florets/flowers attached on a clubbed apex of peduncle at almost the same or different points. The inner/young florets are arranged around the centre and closely packed while the older florets are found at the peripheral of the expanded apex of peduncle.
All florets are enclosed by dull coloured; oblong/ovate; hairy; tapering; thick; free; parallel veined; bracts
Floret
Each floret is bisexual; zygomorphic; sessile/unstalked and their petals are brightly coloured; four; thin; curved; veined; lobed; and smooth; fused to form a tube hence are tubular.
Florets have four stamens with large; bilobed; elongated anthers connected to a short; thin; fused with petals filaments.
The florets have a syncarpous pistil that consists of bilobed/bilocular/bicarpel; knob-like; obliquely attached stigma to broad base; superior ovary by a short; thin style. All florets have thin/membranous fused and veined sepals. All the florets are enclosed by dull coloured bracts.</td></tr>
<tr><td>Banana spathe</td><td>The pistil is syncarpous, consists of inferior; elongated; curved; and tapering ovary towards the base, with long; curved; grooved style with trilobed stigma (3 fused stigmatic surfaces) and brightly coloured.</td><td>Flattened; elongated; grooved, bilobed, brightly coloured and curved (shovel) anthers and filaments are long; flattened; and thick</td><td> 
</td></tr>
<tr><td>inflorescence</td><td colspan="3">It consists of a stout main axis/peduncle on which numerous; sessile/unstalked; bisexual; , zygomorphic and clustered florets which are arranged in two rows and attached at the base of inner surface of the dull coloured; prominently parallel veined ,large ,thick(fleshy)and in ward curved/boat shaped spathe/bract.
Each floret has two perianth which are curved/boat shaped; parallel veined; dull coloured and attached to the ovary.
One of the perianth is large and long while the other is short and small.
The pistil of the floret is syncarpous, consists of inferior, elongated and posteriorly tapering ovary, elongated, grooved style with trilobed stigma (3 fused stigmatic surface)
Its stamens consist of long and slender filaments supporting flattened, elongated, grooved, bilobed, brightly coloured and curved (shovel) anthers.</td></tr>
</table>

Hibiscus flower 	***Syncarpous pistil with Five** carpel; and fused; broad; hairy; sticky; branched; stigma attached to free; broad base; superior ovary by long; flexible; thin; slender; free style.*	***Androecium** consists of Numerous; filaments fused with a stamen tube; which is long; end of the filament are free; and attach anthers which are bilobed; round and brightly coloured;*	*Calyx/sepals are Five, fused, taper towards apex; parallel veined; hairy; thick; and dull coloured;*
Morning glory/sweet potato	*2/3 carpels; fused; stigma bilobed/trilobed; round; hairy style; long; thin; superior ovary round and smooth*	*Five stamens, long; free ;and slender ;thin filaments ;hairy at the base attached to the petals; filaments taper at the apex; bilobed; long; large Anthers*	
Guinea grass	*Two feathery brightly coloured; long stigma; style is short; ovary superior and round;*	*Three stamen; filament long ;thin; Anthers pendulous; dull coloured; bilobed large; long loosely attached to filament*	
Guinea grass inflorescence 	*Has main axis/peduncle/rachis with lateral branches of variable length reducing upwards towards the apex; attached oppositely/whorly/alternately having many florets/flowers/spikelets.* ***some spikelets** are single/in groups of 2/3 all having stalks which are of varying length attached alternately on the peduncles and lateral branches/main axis terminating into a spikelet.*		
Gynandopisis gynandra	*Slender; elongated; superior ovary; with short /reduced; hairy style; and bilobed; hairy; spherical; stigma;*	*Free; long ; slender filaments with bilobed ; elongated anthers;*	
Gynandra inflorescence	*Individual un stalked flowers; attached along elongated main axis/peduncle; arranged spirally/alternately; with older flowers lowermost; and younger flowers uppermost; ending at the same level;* ***Petals** are Free; smooth; veined; narrow at base, and broad at the tip; **calyx** are Free; hairy; taper towards the tip/boat shaped /curved inwards;*		

Cassia	*it is monocarpous Pistil; with elongated; dull coloured; curved; and superior ovary; short style and hairy flattened stigma surface.*	Each floret has numerous stamens with filaments of varying length which bear bilobed, elongated, thick and curved anthers with variable sizes.	
Cassia inflorescence	It consists of numerous, bisexual, and zygomorphic florets attached to a clubbed end of the peduncle. Florets have long stalks (pedicel). Florets have curved, free (polypetalous), brightly coloured, large, prominently veined and papery (thin) petals.		
Male paw paw flower 	No Pistil/gynoecium	Ten; brightly coloured; stamens fused with corolla tube; with large; bilobed; elongated anthers attached onto short ; thin filaments;	*Five; fused; short; tapering towards the tip; veined; dull coloured;* Five; brightly coloured; fused forming a corolla tube towards the base ;and towards the apex they are free and broad;
solanum/entengongo	**It** bears lobed small stigma, short hairless style, and superior ovary	Five; brightly coloured; having short filaments, have large; elongated; bilobed brightly coloured anthers	Five; tapering at apex; green in colour; free (separate); bear spines and dull coloured.**Use of spine** is for protection against predation.**green colour** is for photosynthesis
 			Five; bright coloured; fused; large (broad); smooth; lower surface covered with hairs; veined and bear pollen guide; **Brightly** coloured to attract pollinators (insect). **large to** provide a large surface area for landing of the insects,

Example: **floral formula of cassia**

$K_{(5)}\ C_5\ A_{10}\ \underline{G}_1$

The floral formula of a hibiscus

⊕ ♀ $K_{(5)}\ C_5\ A\infty\underline{G}_5$

$K_{(5)}$ = Five fused sepals or calyx

C = Five free petals or corolla

A_{∞} = numerous stamens
$\underline{G}_{(5)}$= Superior ovary with five fused carpals

Floral formula of bougainvillea flower

$\oplus$ ♀ $P_{(5)}A_{8}\underline{G}_{1}$

The number of each floral part is represented by numeral subscript to the symbol.

=petal in the corolla

=sepal in the calyx

=single bilobed anther

=gynoecium of four fused carpels

=used to connect fused parts

A FLORAL DIAGRAM is a floral map representing the different parts of a flower, their number, structure, the relation they bear to one another and their arrangement on the mother aA floral diagram is constructed on a series of *concentric circles*, one for each *whorl* (floral part).

On each circle, are drawn the various floral segments in their correct relative positions and showing fusions of parts where these occur.
Standard symbols used in making the floral diagram representing the different floral whorls.

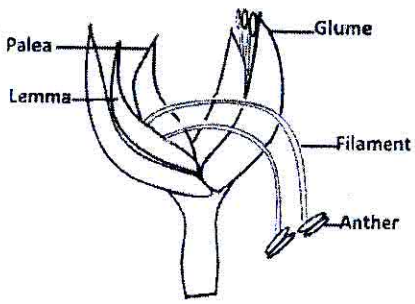
When constructing a floral diagram, *hold the flower so that the pedicel is furthest from you and the petals face you directly.*

DESCRIPTION OF THE STRUCTURE OF THE INFLORESCENCE AND FLORETS

INFORESCENCES;
Is a collection of flowers borne on the same main stalk or arrangement of flowers on plants.
Each flower is called is a **floret.**
A floret may be free or they be closed in the set of bracts.
***An inflorescence** also* refers to the growth of many flowers on the same stalk. The stalk that bears the flowers is called **peduncle** or main axis .It may be divided into branches of different length or not divided.
Glume-is a bract like structure, two of which enclose a spikelet.
Lemma/lower/outer bract - is a small bract in whose axil arises a grass flower.
Palea/upper/inner bract - a small bract arising from the axil of a flower stalk, just above the flower

1. MAIZE INFLORESCENCE

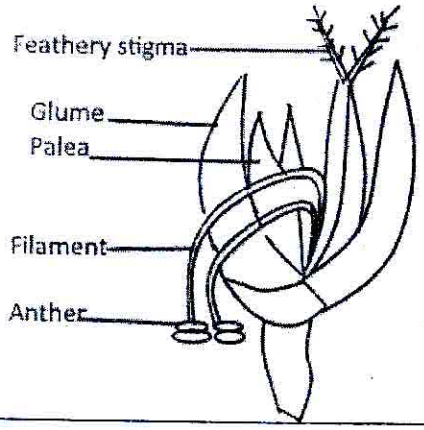
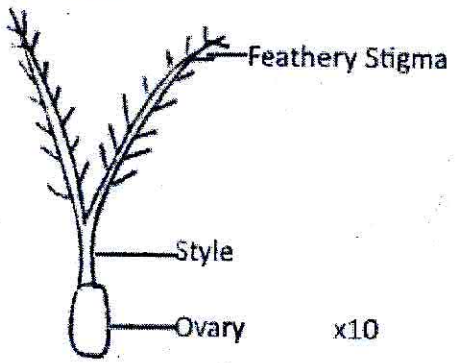
Drawing showing Maize spikelet

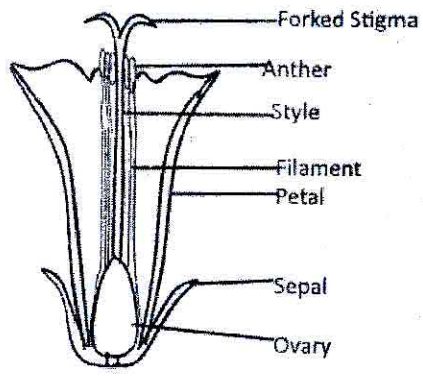
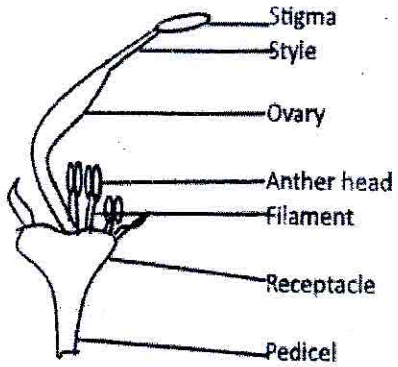


The advantage of alternate arrangement of florets

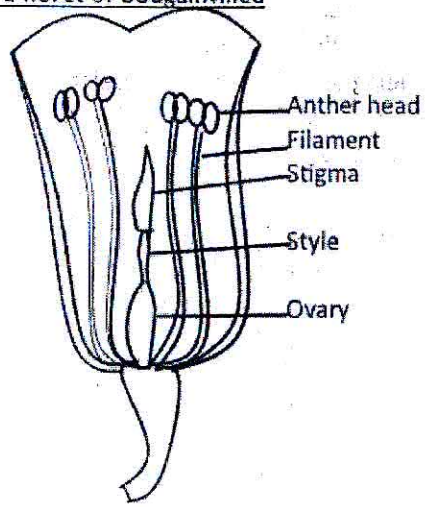
- Is to expose the florets for easy pollination.
- The advantage of the floral arrangement of florets or spikelets is that it makes the inflorescence large or conspicuous to the herbivores for easy predation.
- The large anthers produce numerous pollen grains that make pollination easy.
- The loose attachment of anthers to the filament makes pollination easy.
- The long nature of filaments exposes the anthers hence making pollination easy.

guinea

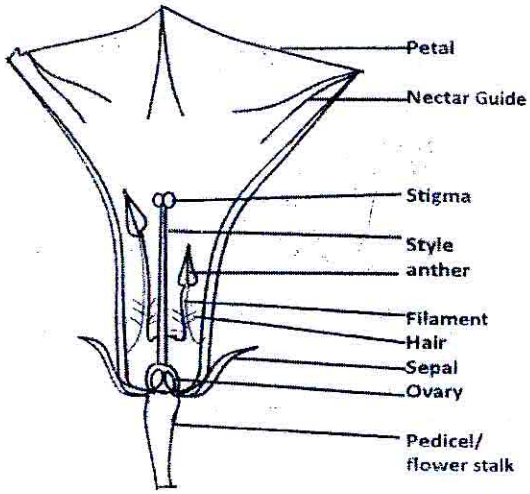
The drawing of panicum maximum floret (Guinea grass)	**Drawing showing Gynoecium of panicum maximum**
Drawing of Panicium Maximum Floret 	Drawing showing Gynoecium of Panicum Maximum 

Drawing of the Tubular floret of Bidens Pilosa	Drawing of a cassia flower after removing petals
	

Drawing showing essential structures of a floret of Bougainvillea



Drawing of longitudinal section of morning Glory



INFLORESCENCE OF GYNANDROPSIS GYNANDRA

This is common inflorescence with many florets which are alternately /spirally and individually attached by long pedicel along pedicel along one main peduncle. The mature or lower florets have longer pedicel than younger or upper florets making all the florets attain the same level each florets has;

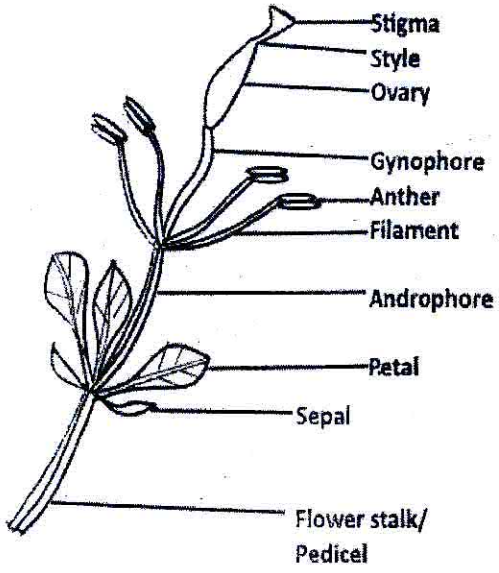
Each floret has;

- No bracts
- **Calyx/sepals**: Five, green. Net Veined, hairy, free, tapering towards the tip/curved.
- **Corolla/petals**: Five, free, smooth, veined, narrow base and broad apex.
- **pedicel** :Long, smooth and bright coloured
- **Stamens** with long, slender, free, smooth filaments with elongated, bilobed, bright coloured anthers.
- The elongated anthers produce large amounts of, pollen grains to enhance cross pollination. The stamens are exposed to ease dispersing of pollens to enhance cross pollination.
- **Pistil** with superior, elongated, hairy, slender **ovary** and short hairy **style**, and bilobed, spherical **stigma**. The spherical stigma provided a large surface area for landing of the insects during pollination.

Note .the bright coloured structural features of these features of this flower attracted pollinator leading to cross pollination by insects.

The receptacle of each floret has distinct internodes and nodes to which floral structures are attached .its stamens are attached to long internodes called **androphore** and the ovary is attached to internodes called **gynophore**. This arrangement exposes the essential structures of the flower for easy pollination leading to ensured higher chances of fertilization.

Drawing of the external features of gynandropsis gynandra



Note.

- The inflorescence that is pollinated by wind has pollen grain which is small, round /circular and smooth .being small reduces its weight so that it can easily be blown by wind. The smoothness reduces air resistance and hence blown by air easily.
- The inflorescence pollinated by insects is large, circular and spiky surface easily attach on to the insect or stigma to easy pollination. The large size of pollen provides a large surface area for attachment to the insect.**NB.** The florets considered above are aimed at acquainting the students and the teachers with the necessary information that can be used to analyze any other flower and inflorescence.

Specimen	Characteristics of androecium	Characteristics of gynoecium
P Hibiscus flower	*Numerous; filaments fused with a stamen tube; which is long; end of the filament are free and attach anthers which are bilobbed; round and brightly coloured;*	***Five** carpel; and fused; broad ;hairy ;sticky stigma leads style long; flexible free superior ovary broad base*
Q Crotalaria flower	*10 stamens ,nine fused into stamen tube; which are grooved; curved and long with free short filaments, anthers bilobed;round;elongated;brightly coloured*	*One carpel; stigma long/flattened;hairy;short style ;superior long curved smooth ovary*
R Morning glory/sweet potato	*Five stamens,long;free;and slender ;thin filaments ;hairy at the base attached to the petals;filamebts taper at the apex; bilobed;long;large Anthers*	*2/3 carpels;fused;stigma bilobbed/trilobbed;round;hairy style;long;thin;superior ovary round and smooth*
flower of S Guinea grass	*Three stamen; filament long ;thin; Anthers pendulous; dull coloured;bilobed large; long loosely attached to filament*	*Two feathery brightly coloured;long stigma; style is short; ovary superior and round;*
flower of T maize	*Three free stamen; free filaments; anthers free; long; slender pendulous smooth large bilobed brightly coloured and loosely attached to filament which are thin, long, flexible and slender.*	**No gynoecium**

FRUITS

These are mature fertilized ovary containing seeds. Some fruits develop from unfertilized ovaries and are therefore seedless **(parthenocarpy).**

Features of a fruits

- Fruits have a pericarp (fruit wall).
- Two scars
- Have seeds(ripened ovules)

The fruits with dry pericarp are referred to as **dry fruits (**dry dehiscent and dry indehiscent fruits) and the ones with fleshy pericarp are called **succulent fruits.**

Fruits are classified into two major groups, the **false fruits** that develop from the receptacle and ovary like an apple fruit and the **true fruits** that develop from the ovary only for example mango fruit.

True fruits are divided into three groups;

- **Multiple fruit** which develop from several flowers whose ovaries fuse after fertilization like pineapple.
- **Aggregate fruits** which develop from one flower with many free carpel/pistil like sun flower.
- **Simple fruits** .these develops from single flower/ovary with one carpel or many fused carpels .e.g. .avocado, tomatoes.biden pilosa and maize grain.

Simple fruits are classified into two major groups depending on the nature of the pericarp.the **dry fruits** and **fleshy fruits.**

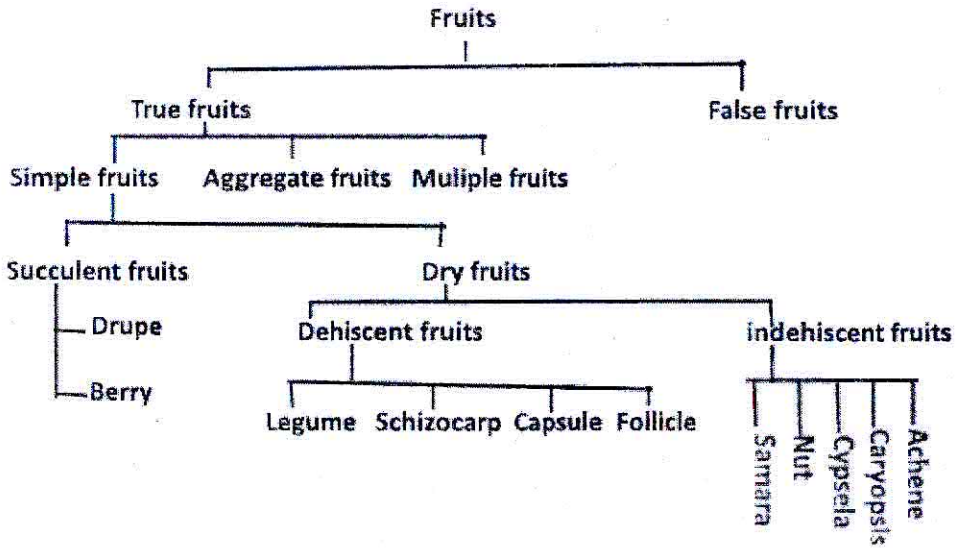
Succulent /Fleshy fruits are the ones with the fleshy pericarp enclosing the seeds. Their pericarp is distinctively divided into three layers, the pericarp, mesocarp and endocarp.

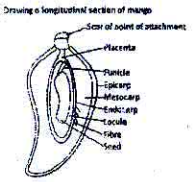
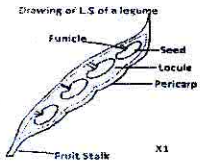
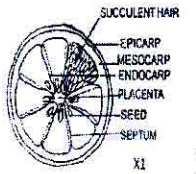
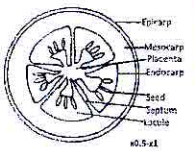
Succulent /fleshy fruits are classified into two groups .the **berry and drup fruits.**

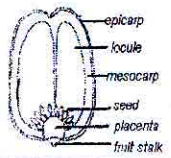
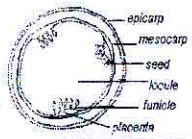
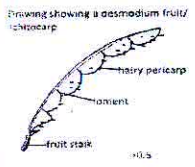
a **berry fruit** has a fleshy pericarp with many seeds for example tomatoes ,and oranges .the many seeds increase chance of dispersal by germination of few remaining seeds if most of the seeds are destroyed .many seeds are cause faster multiplication of plants.

A drupe fruit has a fleshy pericarp with one large seed as shown in avocado and mango. The large seed stores more food to increase the chances of dispersal by keeping the seed viable for a long period of time (by increasing storage)

CLASSIFICATION OF SIMPLE FRUITS



Fruits	Structural description
P(mango/ Avocado) 	*Has one seed; enlarged seed ;relatively thick epicarp and hard ;thin **endocarp**; fleshy/succulent ; thick **mesocarp**; has one locule/ no septa ; the seed is attached to the placenta at the base; by a long funicle/the seed is located in the centre of the fruit/centrally located in the fruit.* Thus it has **apical** or **basal** placentation ***How it is Dispersed*** *Fleshy/thick mesocarp of the fruit is eaten and the seed is thrown away to another place* ***Adaptation for its being dispersed by the agent(animal)*** *Has brightly coloured pericarp/conspicuous to attract animals* *Has fleshy/succulent mesocarp eaten by the animal* *Has strong scent to attract animal*
Q(Bean pod) 	Has dry pericarp; *More than one seed* /many large sized seeds; many locules; **seeds** are attached along one margin of the pericarp/marginal placentation; smooth outer surface of the pericarp; two sutures/lines of weakness; **Adaptations for survival** *Has two sutures along which it splits open when dry to release the seeds easily* *Has many seeds for fast multiplication* *Has a large/big sized seed to store enough food to promote germination* ***How it is Dispersed*** *Has two sutures along which it splits open when dry to release the seeds to another place* ***Adaptation for self its being dispersed by the agent(self)*** *Has two sutures through which it splits open when dry to release the seeds* *Seeds are loosely attached to one margin so as they are released easily*
R (orange) 	*Has Many seeds; thick endocarp; juicy endocarp; thin and spongy mesocarp; many locules; has succulent/juice hairs; has citric acid glands/oil glands; Has thick epicarp; stony seeds ;* Seeds are radially attached to the central placenta/ *placenta at the centre;* **Axile** placentation ***How it is Dispersed*** *The animal picks the fruit eats the succulent/fleshy endocarp and then throws away the seeds to another place* ***Adaptation for its being dispersed by the agent(animal)*** *Has brightly coloured pericarp/conspicuous to attract animals* *Has fleshy/succulent mesocarp eaten by the animal* *Has strong scent to attract animal*
W(tomato) 	Has a thin/membranous and bright coloured epicarp when ripe: thick and fleshy **mesocarp**; juicy/succulent pericarp; endocarp divided into many locules ; has many septa; many seeds **Placenta:** is fleshy, lobed and centrally positioned, thus it is **Axile** placentation. its seeds have short funicle and are radially arranged around the central placenta ***How it is Dispersed*** *It has brightly coloured thick/succulent/fleshy pericarp when ripe which is eaten by the animal the seeds resist digestion/not digested and passed out in faeces elsewhere or to another place*
S(cucumber)	*Has many seeds; divided pericarp or mesocarp and endocarp) placenta at the periphery/outer side; fleshy/succulent mesocarp and endocarp; placenta at ¾ points; seeds arranged in regular manner; locule divided/three locules/chambers ;has many septa; prominent long funicle* ***Seed arranged**: Many seeds suspending/radiating/pointing inwards; at 3/4 points/sites; in a regular manner*

T(green pepper) 	*Has many seeds; divided pericarp; placenta central; placenta arises from the base; locule divided/has septa; seeds clustered on the placenta* Its locule is partially divided by septa.it has a free central and thick, spongy placenta arising from the base. It has many hard flattened seeds which are clustered on the placenta. Thus it has a *Free central Placentation*
U (paw paw) 	*Has many seeds; divided pericarp; or mesocarp and endocarp; placenta peripheral/outer side; fleshy /succulent mesocarp; papery/thin endocarp; rough seeds* Its pericarp is divided into mesocarp and endocarp. Mesocarp is fleshy and thick. The placenta forms a thin lining around the inner wall of the pericarp and this is where the rough, clustered seeds are attached radially and in a regular manner at the peripheral wall by short funicle. It has one locule. Thus it has a *parietal placentation*
Schizocarp/ lomentum 	***REASONS FOR BEING A SCHIZOCARP*** • has transverse lines of weakness/ sutures • has loments/ segments that contain one seed • has separate compartments/ sections **How they are dispersed** Has sticky hairs; which attach on fur/ clothes;/ body/skin of animal whiie moving;/ passing and is droped/ removed off to another place/throws it away to another place;

Dry fruits: these are fruits with dry pericap. They are divided into two groups the dry **indehiscent fruits and dehiscent fruits.**

INDEHISCENT FRUITS: these fruits that lack sutures on their pericarp thus their pericarp cannot break/dehisce/split to release the seeds when dry .

They are divided into various groups as follows;

1. Caryopsis: its testa is fused with the pericarp as seen in maize grain.

2. Cypsela. It has pappus /persisting hairy calyx for example tidax procumbens.it is adapted to wind dispersal due to possession of pappus (hairy calyx) which makes it float in air .it has one seed.

3. Achene .has one seed with a pericarp not fused with the seed coat .it has hooked persisting calyx .hence it is dispersed by animal for example bidens pilosa.

It attaches onto the hairy body of the animal that removes and throws it away to cause dispersal.

4. Samara .its pericarp is modified into a wing structure that makes it float in the air like Jacaranda nimbuifolia fruit leading to dispersal .it has one seed.

DEHISCENT FRUITS

These are dry fruits with sutures along which they split when dry to cast the seeds they are divided into various groups depending on the number of sutures in their pericarp.

1. Schizocarp, they break transversely when dry into one seeded parts with sticky hairs on pericarp like Desmodium and some cassia species.

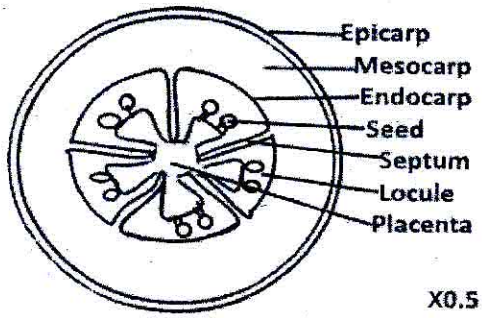
2.Follicle; a fruit with dry pericarp which is formed from one carpel and splits down from one side.e.g Sodom apple and cassia

3. Legume; dry pericarp with two sutures and many seeds for instance bean pod. When dry it splits along the sutures (lines of weakness) to release the seeds .the seeds are attached along one margin of the pericarp .hence it has marginal placentation.its seeds are enlarged with short funicle. The many seeds increase chances of dispersal. It also leads to fast multiplication of plants (legumes)

4. Capsule; it has a dry pericarp with many seeds and with more than two sutures for examples Dutch man's pipe. When it is dry .it dehisces/splits along many sutures to release the seeds.

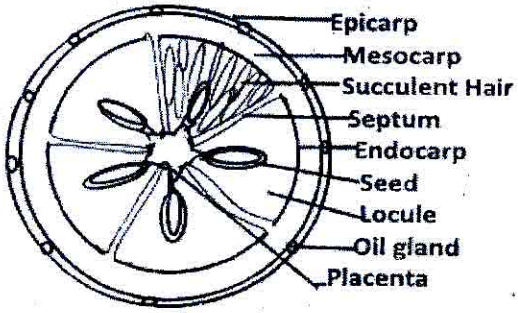
TABLE SHOWING LABELLED DRAWINGS SOME FRUITS

Cross section of Tomato Fruit

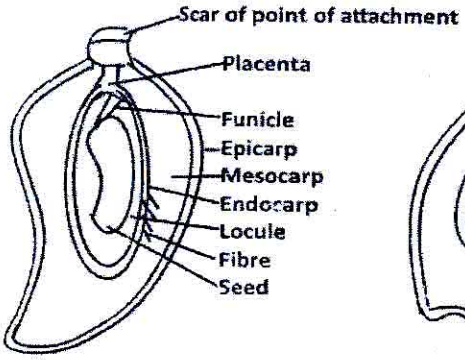


X0.5

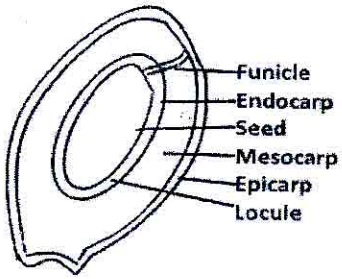
Cross section of an Orange Fruit



Drawing o longitudinal section of mango

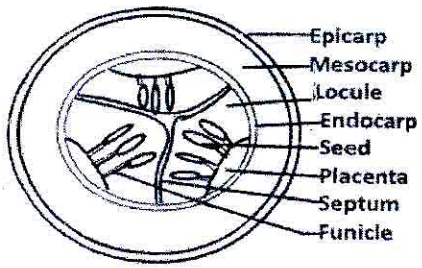


Drawing of longitudinal section of Avocado



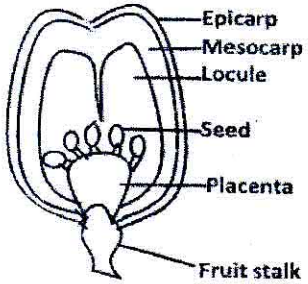
x0.5

Drawing of the coss section of Cucumber



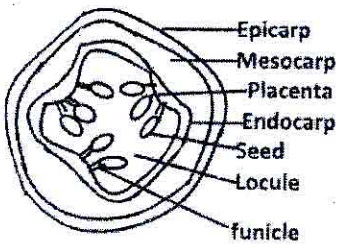
X0.5

Drawing showing L.S of Green paper

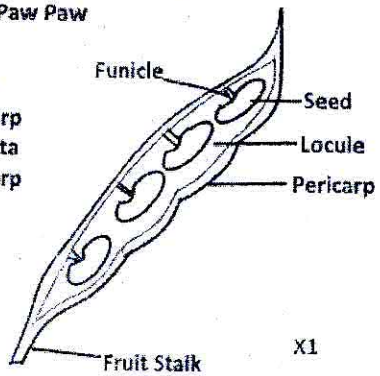


L.S of a Bean Pod

Drawing showing Cross section of Paw Paw



x0.5



X1

PRACTICAL QUESTIONS TO GUIDE STUDENTS PRACTICE ON DISSECTION

A.COCKROACH

1a) You are provided with specimen **Y** which is freshly killed. Cut off appendages at their proximal ends; remove all the wings including the tegmina. Describe the structure of the animals' body. **(10 marks)**

b) Lay the animal dorsal side upper most. Lift the 10^{th} abdominal tergum. Draw and label the visible structures of the specimen. **(03Marks)**

c) Describe the visible structures attached on the ventral and dorsal cuticle.

(4 marks)

d) State the sex of the specimen. Describe the structures used for determining the sex. **(02marks)**

2a) you are provided with a freshly killed cockroach, labeled specimen Q. lay the animal ventral side uppermost. Observe the structures posterior to the trochanter of the hind limbs. Draw and label the dorsal view of the observed structures **(05mks)**

b) Lay the animal dorsal side upper most. Cut through the left lateral side of the abdomen and thorax, leaving the anterior most segment of the animal intact. Lift the dorsal cuticle and displace it to one side of the specimen. Cover the dissection with water and clear away the fact bodies and displace the alimentary canal to the right of the specimen. Draw and label the exposed structures on both cuticles.

(18 marks)

3. You are provided with a freshly killed cockroach.

a) Cut off the antenna from its base. **(02 marks)**

i) Measure and record the length of the antenna and the rest of the body

ii) What is the significance of the ratio in promoting the survival of the features? **(02 marks)**

b) Examine the antenna and describe its structural features **(05 marks)**

c) Explain three ways the antenna is suited to its functions. **(03 marks)**

i) Identify the sex of the cockroach, and draw and label those external features which you used to determine the sex of the cockroach. **(4 marks)**

(ii) Remove the wings of the specimen. Pin down the specimen with the dorsal side upper most. Lift the free edge of the tergum in the middle of the right lateral side of abdomen. Cut the anterior edge of the terga and remove all the terga except those posterior to the middle of the abdomen. Avoid damaging the organs.

(i) List all the visible organs after removing the terga **(4marks)**

(ii) Make a fully labeled drawing of the digestive system **(8 marks)**

4. You are provided with a freshly killed specimen B.

a)Using a hand lens examine the antennal socket and four proximal segments of the antenna.

i) Describe the structural features of this part of the antenna **(2 ½ marks)**

ii) Draw and label this part of the antenna (05 marks)

b) Cut off the tegmina, posterior wings, antennae and limbs, place the specimen dorsal side upper most, cut through its right lateral side and dissect to expose the structures with in the abdominal and thoracic regions. Displace the salivary glands to the right of the specimen. Displace the alimentary canal to the left. Remove all unnecessary tissue to display the alimentary canal and the structures on the ventral cuticle the gut posterior to the mid gut. Draw and label structures exposed in your dissection (18 marks)

5a) Using a hand lens examine the compound eye, fenestra, antennary pit and antenna. Describe their structural features. (06 marks)

b) Examine the head region, search for the mouth parts, describe their relative positions and associated structural features. (06 marks)

c) Using a low power microscope, examine the ventral view of the pretarsus.

(i) Describe the structure of pretarsus. (3 marks)

(ii) draw and label (4 marks)

d) Place the animal ventral side upper most. Draw and label the posterior end of the abdomen together with its associated structures. (3 marks)

e) Place the specimen dorsal side upper most, cut through the left hand edge of the exoskeleton of the abdomen and dissect to expose the structures within the abdominal region. Displace the alimentary canal to the left of the animal. Remove the unnecessary tissues to display all the parts of the alimentary canal and structures on the dorsal cuticle. Draw and label. (18 marks)

6a) Using a scalpel, cut off the third leg of the specimen. Examine the inner view of the leg using a hand kens. Draw and label (10 marks)

b i) examine the tarsus, draw and label. (4 marks)

ii) Outline the adaptations of the tarsus to its functions. (04 marks)

c) Search for the spiracles.

i) Describe their location and their structure (3 marks)

(ii) Draw a thoracic spiracle (4 marks)

iii) Outline the difference between the thoracic and abdominal spiracles (3 marks)

d) Using a microscope, examine the antenna care fully

i) State three adaptive features of the antenna. (3 marks)

ii) Make a large labeled drawing of the antenna. (6 marks)

7a) you are provide with specimen A. examine the mouth parts and describe the structural features of the mouth parts (10 marks)

b) Draw and label i) mandible (4 marks) ii) maxilla (4 marks) iii) labium (4 marks) c) Lay it on the dissecting board, dorsal side upper most. Cut along the left lateral line except the posterior three terga. Do displace the alimentary canal to the right. Draw and label the structures exposed on both the ventral and dorsal cuticles. (17 marks)

8) You are provided with specimen Y. Examine it carefully and answer the questions that follow. Display the animal on the dissecting board with the dorsal side upper most. Cut along one lateral line of the abdomen, except its three anterior most segments and displace the dorsal terga to the left and alimentary canal to the displace the dorsal terga to the left and alimentary canal to the right. Draw and label the structures exposed on the ventral and dorsal tergum that are used for removal of insoluble nitrogenous waste production, sexual reproduction, coordination, breakdown and absorption and transport of the digested nutrients and oxygen (22 marks)

9 a) you are provided with specimen A which is freshly killed. Cut of the head and boil it in caustic soda/ alkali (sodium hydroxide) until when the head sinks. Cool the alkali and remove the head. Isolate carefully the first maxilla, second maxilla (labium) and the mandible. Draw and label these structures. (12 marks)

i) How are these structures drawn adapted to their function/roles? (10 marks)

b) Proceed to dissect and display all the structures lying on the dorsal cuticle. Draw and label (8 marks)

10. You are provided with specimen P which is freshly killed.

a) Cut off the wings and legs of the specimen. Examine the dorsal and ventral parts of the abdomen.

i) Give three differences and similarities between the two cuticles. (6 marks)

ii) Explain how descriptions in a (i) above relates to the mode of life of the animal..

(6 marks)

b i) Pin the specimen in the wax dish with the ventral side towards the wax. Dissect along the lateral line and remove the dorsal cuticle completely from the specimen. Turn this cuticle so that the internal structures are seen. Draw and label structures on the dorsal and ventral cuticles without displacing any. (12 marks)

ii) Explain how the cuticle can be of advantage or disadvantage in the animal's life.

11. You are provided with specimen **X**. use the specimen to answer the following questions.

a) Cut off limbs completely to expose the thoracic segments clearly. Turn the specimen so as it faces you. Draw and label the anterior half of the specimen.

b) Carefully remove the following mouth parts: Mandible, maxilla and labrum. Examine each of them under low power magnification of the microscope. Draw and label. (12 marks)

i) For each of the structures, give three descriptive features

b) Dissect the specimen as follows

ii) Pin the specimen with the dorsal side upper most

iii) Cut along the lateral line of the abdomen to the right hand side except the posterior most segment and displace the dorsal cuticle to your left.

On the same drawing, draw and label the structures on the dorsal and ventral cuticle.

12. a) Using a magnifying lens, examine the structures found on the head region of specimen E provided. (4 marks)

i) State four features observed from the head region used to classify the specimen

ii) Using low power magnification, observe the left compound eye and the first three segments at the base of the antenna. Make an accurate drawing but don't label (6 marks)

iii) Give three descriptions of the compound eye and relate each description given to the role of compound eye in the specimen. (6 marks)

b) Detach all the legs by carefully cutting at the point of attachment to the thorax. Then observe the structures found in the anterior half of the specimen using magnifying lens

i) Make an accurate drawing showing the structure in the anterior half of the specimen from the ventral view. Label only the segmented structure. (15 marks)

13) You are provided with a freshly killed cockroach, using a hand lens examine the dorsal view of the head. Draw and label. (7 marks)

b) Describe the antenna and explain how they are adapted to their function.

c) Place the specimen dorsal side uppermost. Cut one lateral line of the specimen to display organs that comprise the vascular, nervous, reproductive and excretory system. Draw and label the structures exposed in your dissection with the dorsal cuticle displaced to the right and alimentary canal to the left of the specimen. **(18 marks)**

14. Cut through the right lateral side of the abdomen and the two posterior most segment of the thorax, leave the prothorax intact. Displace and hold the dorsal cuticle to one side of the specimen. Cover the dissection with water and clear away the fat bodies. Draw and label the exposed structures on both cuticles. (17 marks)

B. TOAD / FROG

1. a) Carefully examine the external features of the head and describe its structures. (10 marks)

b) Using dissecting instruments open the buccal cavity widely. Describe the structural features in this part of the body. (10 marks)

c) Explain three ways the structural features of the buccal cavity suit their function.

d) Dissect the specimen to display the arterial circulation on the left side lying posterior to the heart plus the associated structures. Draw and label the displaced structures. (20 marks)

2. a) Describe the structure of the fore and hind limbs. (10 marks)

b) Explain how the structures of the hind limbs are related to their functions. (10 marks)

c) Out line three observable differences between the fore and hind limbs (3 marks)

d) Dissect the animal to display the routes of blood flow from the right hand side anterior to the trunk of the specimen. Draw and label your dissection. (20 marks)

3. a) Examine the ventral and dorsal surface of the trunk. Outline three differences between the two surfaces. (03 marks)

b) Explain the significance of the noticeable differences in (a) above (2 marks)

c) Dissect the specimen to display the:

i) Blood vessels taking blood to the right lung and fore limbs of the animal. With the heart placed dorsally. Draw and label your dissection (16 marks)

ii) Blood vessels supplying blood to the left side of the head and chest region of the animal with the heart in situ. Draw and label your (20 marks)

4a) Describe the following structural features of the head

i) mouth (2 marks) ii) ear drum (2 marks) iii) eyes (4 marks) iv) poison glands (3 marks)

b i) identify the sex of the animal.

ii) Describe the structural features you used to identify the sex (3 marks)

iii) place the animal ventral uppermost.Dissect and remove the skin from the ventral side of the animal's head, abdomen and limbs. Search for the superficial structures, draw but don't label. (8 marks)

c) Dissect the animal to display the blood vessels draining the left side anterior to the heart, with the heart turned forward. Draw and label. (16 marks)

5a) Describe the structure of the foot of the posterior limbs (3 marks)

b) Explain how the structure of the foot is related to its function (2 marks)

c) Dissect the animal to display the heart and gut. Turn the heart forward and search for the vascular system draining the gut, spleen and associated structures. Draw and label. (18 marks)

d) By further dissection search for blood vessels that supply blood to the head, skin and stomach. Leave the heart undisplace. Draw and label (15 marks)

6 a) Explain five ways the animal is adapted to live in its habit. (5 marks)

b) Dissect the specimen to display the:

i) The main routes of blood flow supplying the left anterior region of the specimen.

ii) The main routes of blood flow draining the right hind limb of the animal to the heart, with the heart pinned forward through the ventricle. draw and label your dissection (30 marks)

7. Dissect the specimen to display the:

i) The main routes of blood to the left limb and lung of the specimen.

ii) The main routes of blood flow returning blood from the right hind limb of the animal to the heart when displaced to expose its dorsal surface. Draw and label your dissection

8. Pin the specimen on the dissecting board/dish and proceed to dissect it to display (29 marks)

(i) The blood vessels from the heart to the thoracic region of the specimen and the right fore limb

ii) The blood vessels that transport blood from the part of the alimentary canal anterior to the ileum and other structures within the abdominal region back to the heart. Displace the alimentary canal to your right then with the undisplaced heart. Draw and label your dissection in i) and ii) on the same drawing. (27 marks)

9. Dissect the animal to open up the abdominal, chest and pelvic cavities. Continue to dissect and display the blood vessels from the left hind limb. Remove the alimentary canal and left hand gonads. Display the urinogenital system and the blood vessels that drain blood from it, and body wall of the animal. Draw and label your dissection (15 marks)

10. Turn the dissecting dish sideways, insert one blade of the scissors into the mouth and cut through the right hand angle of the jaw, continuing up to the side of the pharynx and oesophagus. Pin aside the floor of the buccal cavity to display the structures exposed in the buccal cavity without stretching the tongue. Draw and label the structures exposed on the floor and roof of the buccal cavity (14 marks)

11) You are provided with a freshly killed toad.

a i) Carefully observe the animal and explain five structural features that suit the animal to live on either land or water bodies. (5 marks)

ii) Describe the position and structure of the following; webbed toes, cloacal opening, head, tongue (8 marks)

b) Lay the specimen ventral side upper most. Dissect it in the usual way and remove the skin of the head, trunk and fore and hind limbs up to the elbow and knee respectively

i) Draw and label the superficial structures. (13 marks)

ii) Describe the structural features of the skin and clearly indicate, how they relate to function (5 marks)

c) Proceed to dissect and display the internal structures. Displace the stomach further to the right, the right lung to cover part of the heart. Search for blood vessels supplying the stomach, pancreas and the right hand side of the animal anterior to the heart. Draw and label (16 marks)

12. You are provided with a freshly killed frog

a) Observe the fore and hind limbs and describe their stricture. (4 marks)

Fore limb: Hind limb

b i) Outline three differences between the fore hind feet (3 marks)

ii) Draw but don't name the hind foot.

c) Lay the animal ventral side uppermost. Dissect it in the usual way to display internal structures

i) Turn the dish sideways and cut through the right angle of the jaw, pharynx up to oesophagus. Pin a side the floor of the buccal cavity and pharynx. Search for structures used for feeding ii) Search for blood vessels supplying the gut. Draw and label your dissection (22 marks)

13. You are provided with a freshly killed frog.

a i) examine the head and describe how it is adapted to promoting the animal's survival. (5 marks)

ii) Open the buccal cavity, using dissecting instruments search for a structure at the front of the floor of the buccal cavity, hold the structure, pull it and release it. State your observations and explain their significance in promoting the anima's nutrition. (3 marks)

b) Dissect the specimen and pull the skin off the body wall.

i) Describe its attachment on the body wall. (2 marks)

i) Examine the skin and explain three ways it is adapted to the process of gaseous exchange. (3 marks)

c) Dissect the specimen further to display the routes of blood low

i) Carrying from the head region on the right hand side of the specimen back to the heart

(ii) Carrying blood to the alimentary canal, displaced to the right and to the kidneys, the right turned to appear on top of the left. Without displacing the heart. Draw and label your dissection. (25 marks)

14. You are provided with a freshly killed toad with the mouth opened pull out the tongue and pin it. Draw and label the head as observed in lateral view. (5 marks)

b) Dissect the animal to display:

i) Blood vessels supping the left hand lung, fore limbs, skin and head.

ii) Blood vessels draining blood from the right hand side of the animal except the inner part of the hind limb. Turn the heart forward. Draw and label. (28 marks)

15. You are provided with a freshly killed frog

a) Carefully examine the dorsal and lateral sides of the head

Explain three ways the animal is adapted to live in its habitat.

b) Dissect to display the;

i) Blood vessels supplying and those draining the left hand side of the head and fore limbs.

Blood vessels draining the left hind limb, abdominal wall and skin. Without displaying the heart. Draw and label. (30 marks)

16. You are provided with a freshly killed toad. Dissect and display

i) Blood vessels draining the left hand side anterior to the hear

ii) Supplying the right, lung, gonads and hind limb. With the heart turned forward, draw and label your dissection. (30 marks)

17. Dissect a freshly killed toad (frog) provided to display

i) Vascular system returning blood from the urino- genital system. Ii) Vascular system supplying the right hand side of the head, lung and skin. Without displacing the heart, draw and label.

18a) Dissect a freshly killed frog (toad) provided to display;

i) Routes of blood flow taking (supplying) blood to the excretory and reproductive structures. System)

(ii) Routes of blood flow, returning blood from the inner part of the thigh, and gut. Draw and label (27 marks)

19. You are provided with a freshly killed animal labeled T.

a)i) State the sex of the animal . Give a reason for your answer.

ii) Outline 3 differences between the fore and hind limbs.

b) Lay spacemen T-ventral side upper most, pin it and proceed to dissect, display:

i) Routes of blood flow draining blood from the left hand side of the head and lung to the heart.

ii) Routes of blood flow supplying the right forelimb, part of digestive system anterior to ileum and the urino-genital system. Displace the heart forward. Draw and label. (30 marks)

C) DISSECTION OF THE RAT

1. You are provided with a freshly killed rat

a i) Observe the head carefully and describe five ways its external structural features adapt the animal to live in its habits. (5 marks)

ii) Draw and label the head as you observe it in its lateral and ventral views.

Ventral view (3 marks)

Lateral view (3 marks)

ii) Open the buccal cavity and count the number of teeth. Write the dental formula. (2 marks)

b i) Dissect the animal to display the superficial structure in the neck. Draw and label. (10 marks)

ii) Proceed to dissect and display internal structures posterior to the diaphragm. Observe them in the undisturbed state. Draw and label (12 marks).

c) By further dissection, display the structures used for reproduction and blood vessels supplying blood to them. Draw and label. (10 marks)

2. You are provided with a freshly killed rat. a) Examine the trunk and limbs and suggest five ways the animal is adapted to cope up with the challenges in its habits (5 marks).

b i) State the sex of the animal and suggest two reasons for your answer. (1 ½ marks)

ii) Draw and label the external structures you used to establish the sex of your specimen. (3 marks)

iii) Describe the external structures you would use to identify the mammal of the opposite sex. (6 marks)

c) Proceed to dissect and display reproductive structures and blood vessels associated with them (10 marks).

d) By further dissection

i) Open up the thoracic cavity and display the structures in the undisturbed state in this part of the body.

ii) Displace the liver lobes anteriorly and the stomach to your left. Draw and label the structures in the thoracic cavity and those originally obscured by the stomach on the same drawing (22 marks).

3 a) you are provided with a freshly killed rat. Examine the animal carefully and describe;

i) Structure and distribution of fur. (6 marks)

ii) the structural features of the tail (3marks)

iii) Outline the significance of your observations in a) i) and ii) above to the survival of the animal. (5 marks)

c) Dissect the abdominal region and display the internal structures in this part of the body. Deflect liver lobes anteriorly, displaced duodenum to the right and the rest of structures so that the structures within the mesentery can be seen clearly. Out and remove stomach and spleen. Draw and label. (20 marks)

4. You are provided with a freshly killed rat

a) Dissect the region posterior to the diaphragm to display the digestive system.

i) Describe the structure of the liver and its point of attachment (3 marks).

Displace the liver lobes anteriorly, the duodenum to your left and re-arrange the rest of the gut to display the blood vessels draining the digestive system. Draw and label (20 marks).

b)i) By further dissection, display the blood vessels draining blood from the unrino-genital system. Draw and label

ii) Briefly describe the procedure you performed to display the system in b(i) above. (3 marks)

5. You are provided with a mature mammal labeled specimen R.

a) Measure the length of the whole body, the tail and the rest of the body.

i) Record your results as follows: (3 marks) whole body ..... tail.....

ii) Calculate the ratios: Tail to whole body and tail to rest of the body. (2 marks)

b) Dissect the abdominal region. Displace the liver lobes anteriorly and the alimentary canal to the right. Search for the blood vessels supplying the digestive system draw and label. (20 marks) c) By further dissection open up the chest cavity. Carefully remove the thymus gland, ligature main blood vessels associated with the heart. Cut through these and blood vessels, remove the heart. Search for the respiratory tract and organs for gaseous exchange. Draw and label (18 marks)

6. a) Dissect a freshly killed rat provided, to expose structures anterior to the diaphragm. Remove thymus gland, displace heart to your left. Trace for blood vessels located in the thoracic region. Draw and label

b) Dissect specimen M provided to expose blood vessels draining the structures posterior to the diaphragm. When the gut has been cut out. Draw but label only structures on the right (22 marks)

7a) Dissect the abdominal region to display the stomach. Then shift the stomach to your left and tear off any unnecessary tissues to clearly display the nerves, blood vessels, glands and organs originally concealed by the stomach. Draw and label this portion of your dissection. (12 marks).

b) Continue to dissect to display the blood vessels that supply blood to the digestive system. (23 marks)

8) You are provided with specimen A, which is a freshly killed mammal, dissect the animal to expose the heart in the thoracic cavity. Cut around the heart and remove connective tissue. Remove the heart, Draw and label the heart and remove blood vessels that link it to the body organs as seen in its:

i) Ventral view (15 marks)

ii) Dorsal view (15 marks)

9) You are provided with specimen R which is freshly killed, Dissect the specimen to display the alimentary canal, cut the mesentery to let the organ free and deflect the parts of the displaceable part of the alimentary canal to the right of the specimen. Search for the blood vessels supplying the alimentary canal. Draw and label your dissection. (15 marks)

10) a) Explain five ways the animal uses the structural features of the head to cope up with the challenges in its habitat (5 marks)

b) Lay the animal in the usual way, dissect and remove the skin from the ventral side of the animal. Search for the superficial structures. Draw and label (12 marks)

c) By further dissection, display the mesentery with in the bulk of the intestines trace the lymph nodes in the region of your dissection. Draw and label the junction between ileum, caecum, appendix and colon including structures in the mesentery (15 marks)

11) You are provided with specimen B which is freshly killed. Lay the animal with the ventral side upper most and dissect the specimen to expose the structures in the thoracic region, the heart and the great blood vessels draining the forelimbs. Pin the heart to the right of the animal. Draw and label fully.

12) a) you are provided with specimen B which is freshly killed. (15 marks)

i) Pin the animal on a dissecting board and proceed t o dissect and open up the abdominal cavity. Pin aside the abdominal wall and examine carefully the contents of the abdominal cavity in the undisturbed state.

i) Name five organs visible and state the organ system to which each organ belongs.

ii) Draw and label the structures observed in your dissection. (10 marks)

13) a) You are provided with specimen R which is freshly killed. Examine it carefully and answer the following questions.

i) Describe the features of the ears (3 marks)

ii) Explain 3 ways the ears are suited for their function. (3 marks)

b) Proceed to dissect and expose the heart and structures within the thoracic cavity. Removes the thymus gland, displace the left lung to one side. Draw and label. (15 marks)

14 You are provided with a freshly killed animal T

i) Dissect the specimen to clearly display the structures lying anterior to the diaphragm and posterior to the neck. Without displacing any organs. Draw and label fully (12 marks)

ii) Now proceed to dissect and display the blood vessels returning blood from the left hind limb and the left kidney back to the heart. Draw and label fully. (10 marks)

15 a) Draw and label the feet of the fore and hind limb as observed in ventral view. Draw and label. (10 marks)

END

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