Model Answer of AV-9027

B.Sc. (R.T.) III Semester-2015

RTZ-303: Anatomy & Physiology of Insects

Section-A

Q.1. Objective Type Questions:

(i) Gizzard (ii) Sponging (iii) Heart (iv) None
(v) Spermatophore (vi) Glial cells (vii) Compound eye
(viii) Social (ix) Elephantiasis (x) Stored grains

Section-B

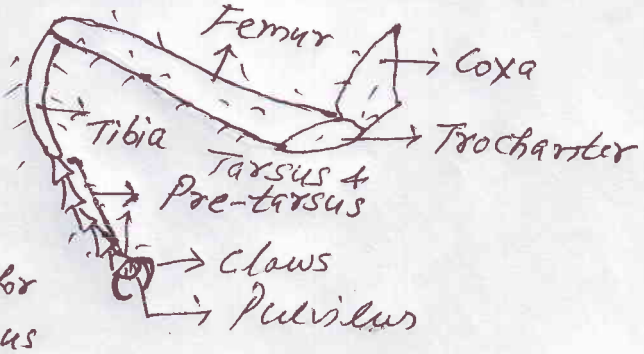
Short Answer Type Questions:

Q.2. Describe basic structure of an insect leg and its modifications.

Ans. Thorax is three segmented and each has a pair of legs.

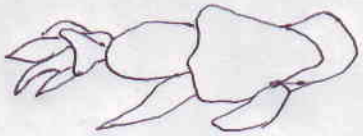
- Basic structure of leg: Insect leg is 06 segmented → Coxa, trochanter, femur, tibia, tarsus & pre-tarsus. Pre-tarsus generally contains 01 pair of claws and a pulvillus. Spines and bristles are generally present on the legs.
- Legs have been modified and adapted to a wide variety of functions including swimming, prey capture, pollen collection, digging, jumping, sound production, etc.

- Type of legs:



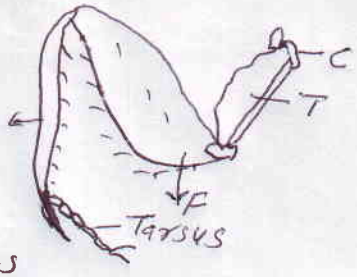
(a) Cursorial:
eg. Cockroach, Bug, etc.
These legs are modified for running or walking. Tarsus touches the substratum while running

(b) Fossorial: These legs are modified for digging the soil. All segments are very short & broad. Stout lobes are used in digging. eg. Dung beetles



(Fossorial leg)

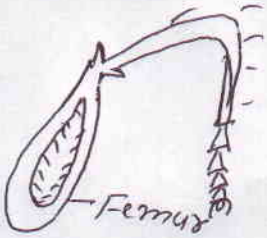
(c) Raptorial: These type of legs are found in predatory insects. Ti
eg. Mantis, Water scorpion, etc.



- While waiting for a prey, its fore legs are held together against the prothorax, then fore legs suddenly shoot forward to seize the prey in a pincer like grip.

(d) Jumping or Saltatorial: eg. Grasshoppers, Crickets, Flea, etc.

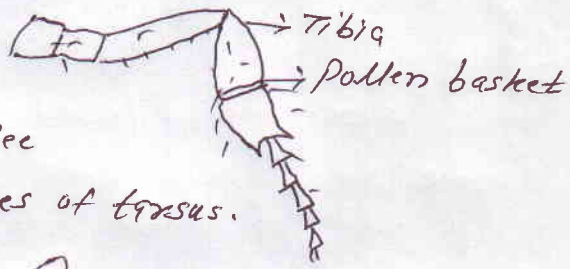
- Femurs of hind legs are enlarged. These accomodate the muscles used in jumping.



(e) Pollen collecting or Foragial:

eg. Metathoracic legs of worker honey bee.

- Tibia bears pollen basket. Bee collect the pollen by stiff spines of tarsus.



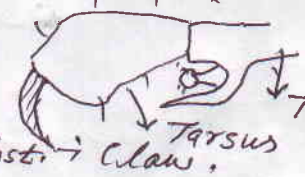
(f) Swimming / Natatorial:

eg. Belostoma, Nepa

- These facilitate the swimming. Tibia, femur and tarsus are flattened and bear swimming hairs. Generally middle and hind legs are modified. Surfaces of legs are greatly expanded which are used as paddles.

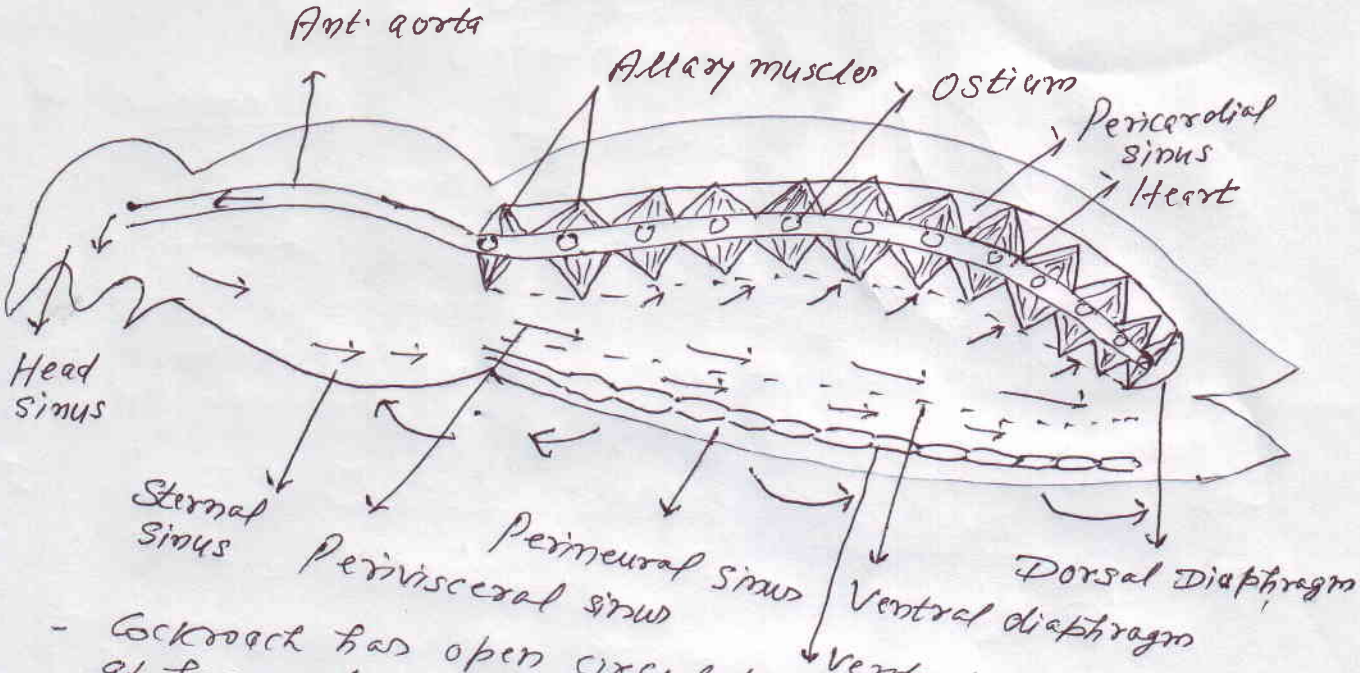
(g) Sound producing / stridulatory: eg. Grasshoppers, Crickets, etc.
- spines are present on the femur (stridulatory crest) which are rubbed against wings.

(h) Clinging / scansorial: eg. Pediculus



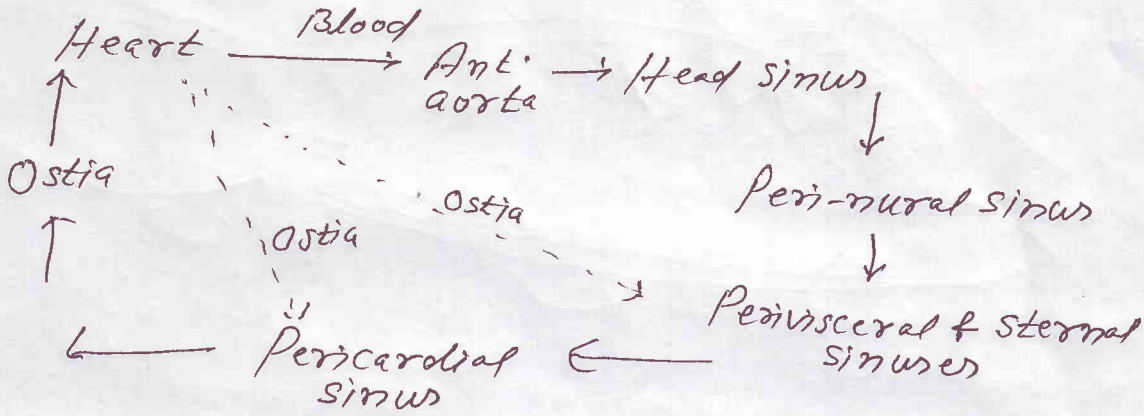
- These are modified to grip the hairs of host. Tarsi are single segmented and each ends in a powerful claw which works against a tibia process.

Q.3. Describe structure of heart of cockroach.

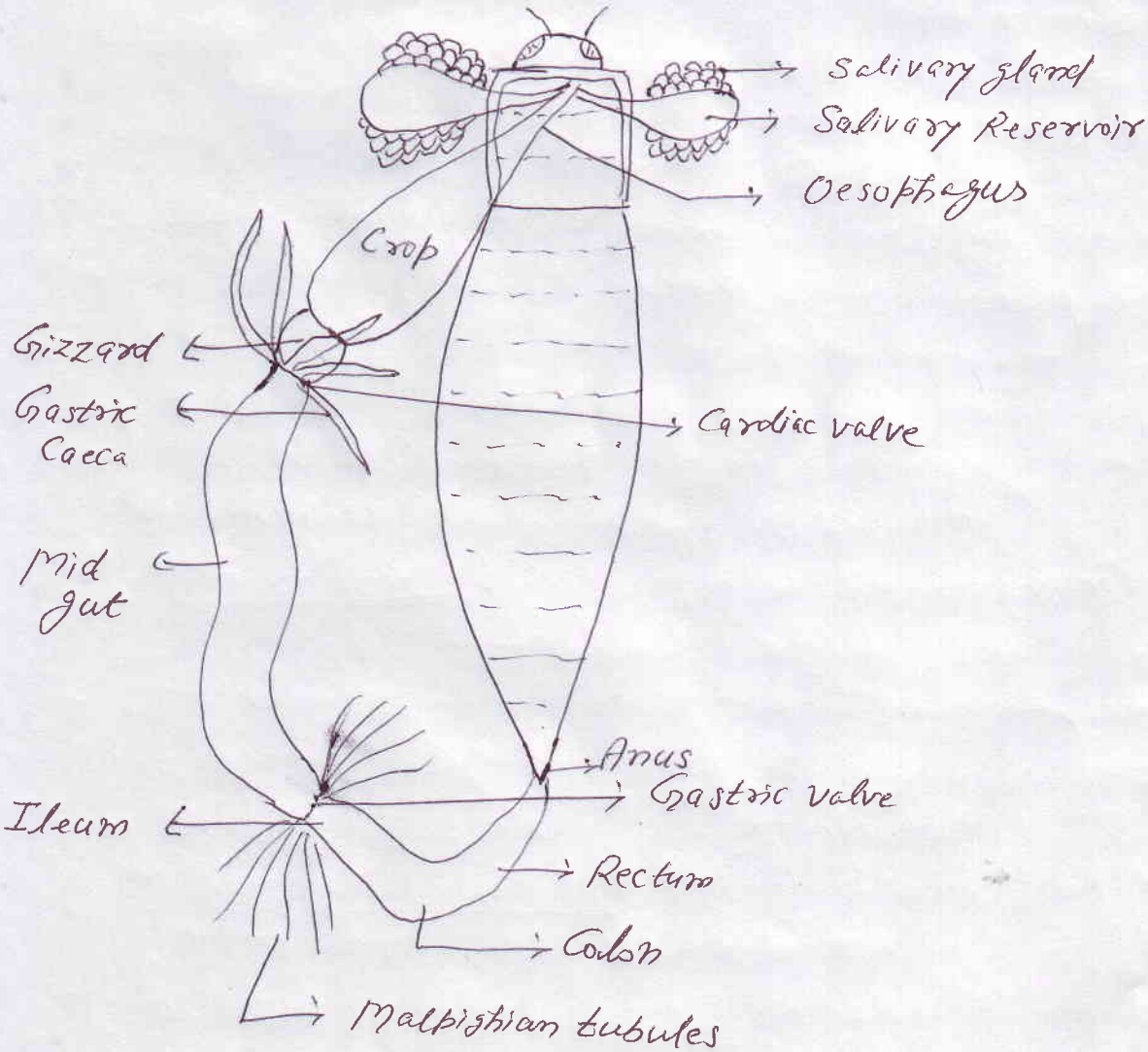


- Cockroach has open circulatory system. It has a dorsal, longitudinal and pulsatile vessel which comprises a post. heart and an anterior aorta.
- Heart: It is 13 chambered which is restricted to abdomen. It is closed posteriorly but opens anteriorly as anterior aorta. It contains following structures.
- Ostia → These are 12 pairs. Blood flows into heart through these at diastole. At systole, blood leaves the heart.
- Alary muscles → These are 13 in number and fan like. These are associated with heart and dorsal diaphragm. These are responsible for the pumping action of heart by rhythmic contraction & relaxation.
- Anterior aorta → It is a tube like structure without ostia. It extends from heart and opens into head sinus.
- Diaphragms → These are two in number → Dorsal & Ventral.
  - Dorsal diaphragm: It is two layered. It encloses heart and alary muscles. It is perforated.
  - Ventral diaphragm → It is located just above the nerve cord and is also perforated.
- Sinuses → Following sinuses are present in the haemocoel.
  - Pericardial sinus → It surrounds the heart.
  - Perivisceral sinus → It is situated between pericardial and perineural sinuses.

- Perineural sinus :- It covers the nerve cord.
- Sternal sinus → It is present in the steral part of the body.
- Head sinus → It is located inside the head.
- Path of circulation :



Q.4. Draw a well labeled diagram of Digestive system of Cockroach.



Q.5. Describe various methods of sound Production in insects:

- Insect produce the sound by varieties of mechanisms.
- Sound play important role in various types of behaviour.
- Sound production is controlled by homones & nervous system.
- Mechanisms of Sound Production:

① As a by-product of some usual activity of insects:
- Sound is produced during feeding, cleaning, courtship, etc.
- Honey bees (250 cycles/sec) and mosquitoes (280-350 cycles/sec) produce sound during flight.
- Bumble beetle also produces sound during pollen collection.

② By hitting body parts on substratum:
- Tapping of head on floor eg. Death watch Beetle (7-8 times/sec.)
- Drumming the ground by metathoracic tibia eg. Male grasshopper (12 times/sec.)
- By tapping of head against roof and mandibles against floor eg. Soldier Termites

③ By stridulation → Two surfaces are rubbed together and a loud sound is produced. Generally metathoracic legs are rubbed on the wings eg. Cricket & Grasshopper.

④ Drumming by Tymbal organs → eg. Cicada
- Air is sucked then abdomen is beaten by one pair of tymbal organs resulting in a loud sound which can be heard from 4-5 km. distance.

⑤ By Pulsed air stream → eg. Death's Head Hawk moth.
- Air is sucked and then exhaled with force, so that epipharynx vibrates (280 cycles/sec.) and high pitched whistle is produced.

Significance → ① Inter and intraspecific communication ② Defense and warning ③ To disrupt echolocation system of bat ④ In courtship ⑤ Isolation and aggregation of species

Q.6. Write an essay on social behaviour in insects:

– It is interactions among members of same species.

I. Type of associations among insects:

① Solitary insects → Each individual is more or less independent eg. Mosquitoes, Dragon flies.

② Gregarious insects → Solitary insects aggregated for some time in response to environmental factors or to share common needs or tract. eg. Locusts, Beetles
– Gregariousness is not a social behaviour.

③ Social insects → Insects of a given species that live together in a organised colony are called social insects. Each individual contributes in some manner to the welfare of all.

II. Evolution of social behaviour → It developed about 300 million years ago in response of parental care life. First progeny is depended on parents than the parents on the progeny.

III. Orders of social insects: Isoptera → eg. Termites
Hymenoptera → eg. Bees, Wasps & Ants.
– Orthoptera & Coleoptera also show social behaviour.

IV – Gradation in social behaviour →

ⓐ Solitary insects →

ⓑ Sub-social insects → eg. Cockroach, Cricket

ⓒ True social insects → eg. Bees, Wasps, Termites & Ants.

– Characteristics of social Insects →

① Large population or colony → Thousands of insects live together in integrated manner. Colony is matriarch type. They never accept the members of other colonies of the same species.

② Elaborate nests → For protection, storage of food and maintenance of broods.

③ Extra-population of nests → Other species of insects live as symbiotic manner of host colony for protection from enemies. eg. Slave making ants & beetles.

④ Polymorphism: For division of labour, have specialized

structures, functions and behaviour. Caste determination is genetical or nutritional. eg. True social insects.

(5) Cohesiveness of colony → All castes live together and by pheromones, they bound together.
eg. Honey bee → 9-oxydecinoic acid.

(6) Parental care → It is instinct behaviour. It includes food collection, feeding of youngs, cleaning, etc.

(7) Progressive provision of food: Provide sufficient food to the larvae until they metamorphose to adults.

(8) Trophallaxis → Exchange of food between one insect and other. It helps in regulation and determination of castes.
- Mouth to mouth feeding → eg. Ants & termites
- Young exchange food with adult.
- Some ants feed some beetles and in return get fluid secreted by them.

(9) Swarming → To avoid crowdness, for feeding, migration and mating eg. Honey bee

(10) Protective devices → stings, jaws, guards, nest in protective localities with several exits.

(11) Communication → by chemical, visual, tactile & auditory signals.

Q.7. Describe biological control of insect in brief.

- Use of natural enemies to control population of pests is called biological control.
- Smith (1919) first used the term "Biological Control".
- Ants are being used to control pests of orchards & stored grains.
- In 1762, Mynah were sent to Mauritius from India to control red Locust.
- Biological control is easily establishable at low cost. This method of pest control is the safest one.
- Different activities of Biological Control:
  - Success of biological control depends on the following activities:
  (1) Collection of natural enemies and release them on pest infested crop
  (2) Rearing of natural enemies and their release

③ Import of natural enemies and release them.
④ It should be ensured that natural enemies should not die after finishing their host pests, instead they should be able to live on some other pests.

- Pre-requisite of biological control:
① Knowledge about species, sub-species and race of pests.
② Knowledge about concerned insect & pest (Geographical distribution).
③ Knowledge about life cycle of pests & natural enemies.
④ Natural enemy should be entomophagous and free from any hyperparasitic insect.
⑤ Knowledge about local and indigenous natural enemies of the concerned pest.

- Effective qualities of Natural enemies:
① Should have capacity to search out their hosts quickly.
② Should be capable to adopt new environment.
③ They should not harm other beneficial insects.
④ Fast reproduction with short life cycle.
⑤ Should not have their hyper-parasites.
⑥ Resistent to insecticides ⑦ Should be reared easily.

- Agents of biological control;
① Predatory vertebrates →
② Predatory and parasitic insects →
④ Predatory insects → They may be monophagous, stenophagous and oligophagous.
ⓑ Parasitic insects → Few are monogenetic & others polygenetic.
③ Micro-organisms → It is called microbial control.
ⓐ Bacteria → eg. Bacillus & Coccobacillus
ⓑ Virus → Polyhedroses, Granuloses, etc.
ⓒ Fungi → eg. Phycomycetes
ⓓ Protozoans → eg. Perizia & Nosema
ⓔ Nematods → eg. Neotylenchus & Rhabditis
ⓕ Male sterility → Sterilized males are released, So population is decreased.

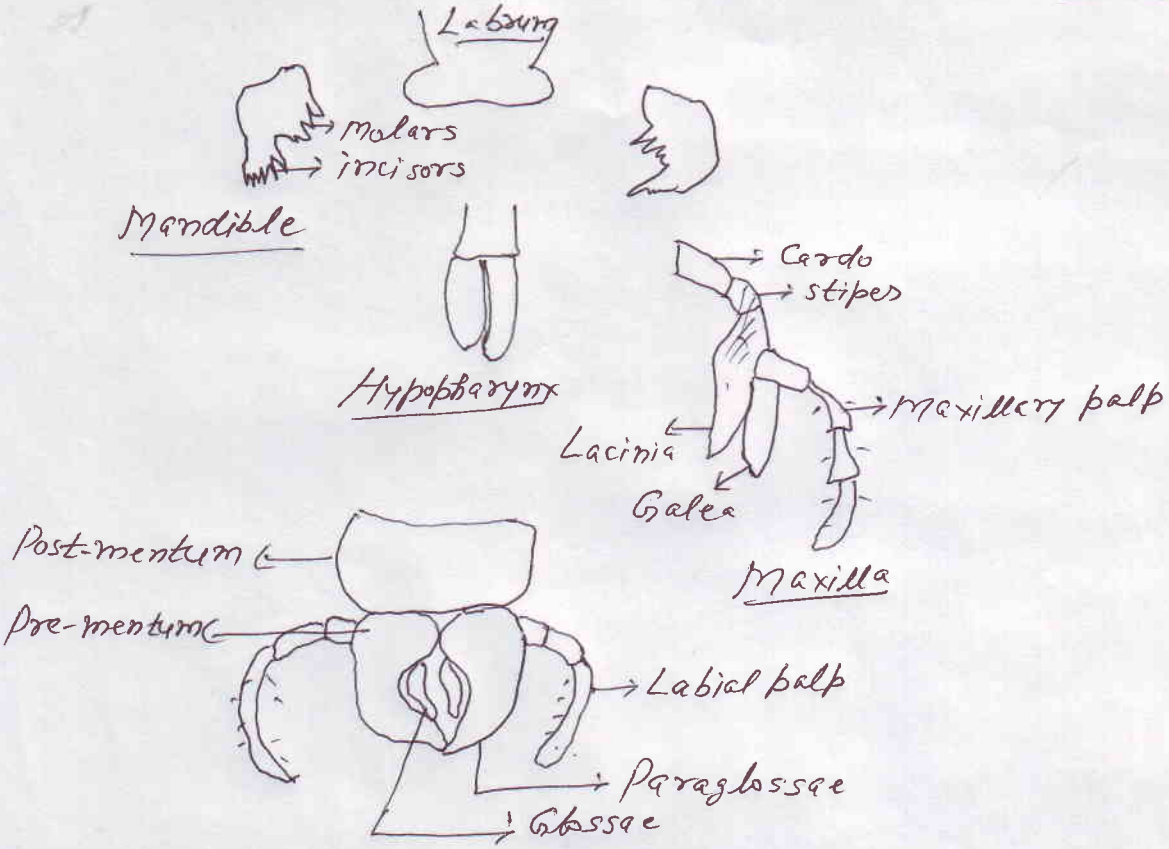
Section - C

Long Answer type questions:

Q. 8. Describe various type of mouth parts present in insects.

- Most primitive type mouth parts are mandibulate type. It has been modified according to food & feeding into several types.

① **Biting & chewing type:** eg. Grasshopper, Cockroach, etc.



ⓐ **Labrum** → It is movable, hangs down from clypeus and covers the mouth. Its inner side forms epipharynx. It acts as upper lip.

ⓑ **Hypopharynx** → It is unsegmented and look like tongue. It releases saliva to moisten the food.

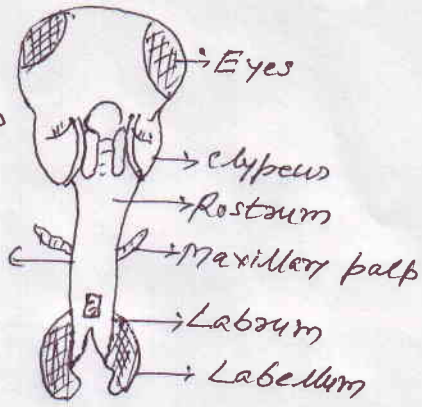
ⓒ **Mandibles** → These are unsegmented & highly sclerotised. Each bears molar and incisor teeth to cut & grind the food.

ⓓ **Maxillae** → one pair, situated behind mandibles. These help in holding & chewing the food. Each is composed of cardo, stipes, galea, lacinia & palpus.

ⓔ **Labium** → It is a composite structure and acts like lower lip. It is composed of Pre-mentum, post-mentum, glossae and paraglossae and bears labial palp

② **Sponging type** → eg. House fly.

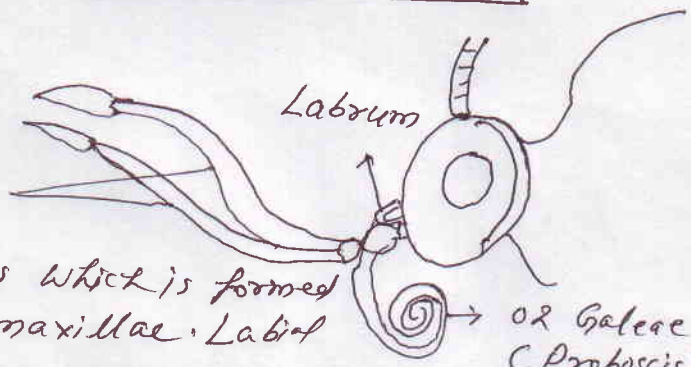
- It comprises a fleshy and retractile proboscis formed by basal rostrum, middle haustellum and distal labellum. Mandibles are absent and maxillae are represented only by maxillary palps



③ Piercing and Sucking type:

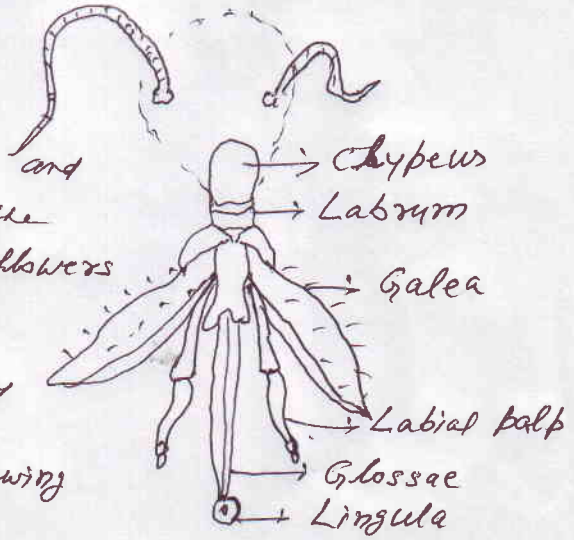
It is composed of mandibles, maxillae, labrum, epipharynx and hypopharynx. These become needle like and ensheathed in the proboscis.

④ Siphoning type → eg. Butterfly and moth



- It has coiled proboscis which is formed by two galeae of the maxillae. Labial palps are well developed. Food channel is situated between galeae.

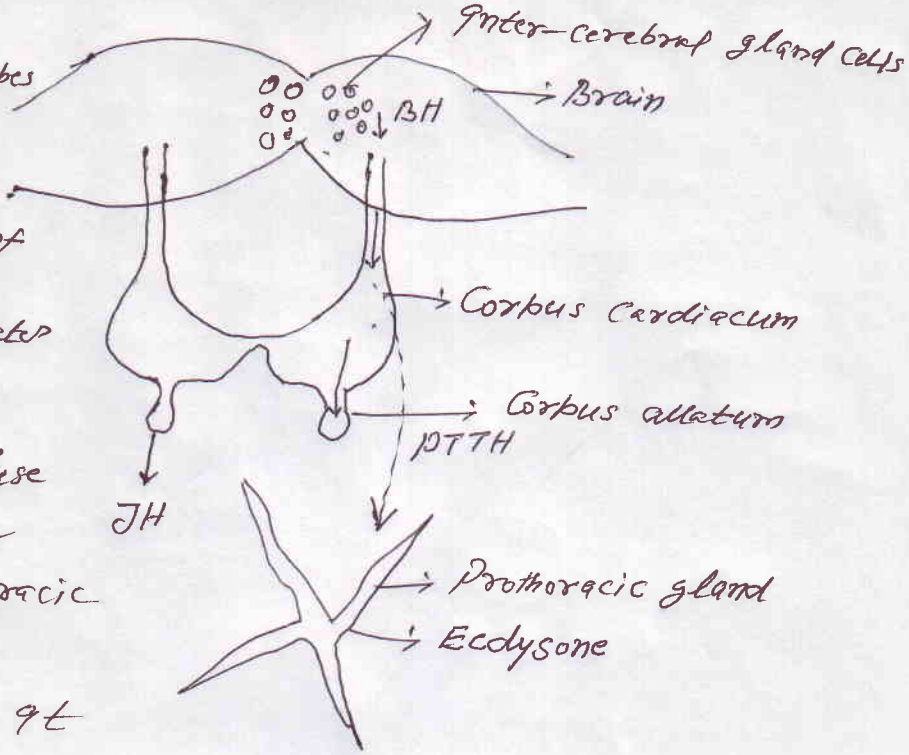
⑤ Chewing & Lapping type → eg. Honey bee & Wasp



- It consists of maxilla and labium and channeled glossa with labellum at the tip which is used to probe deep into flowers to suck the nectors. Other flaps of maxillae and labium forms salivary channel.
- Mandibles and labrum are of chewing type.

Q.9. Write a detail account on Endocrine system of insects:

- Glands →
- Exocrine glands → Types
- Endocrine glands →



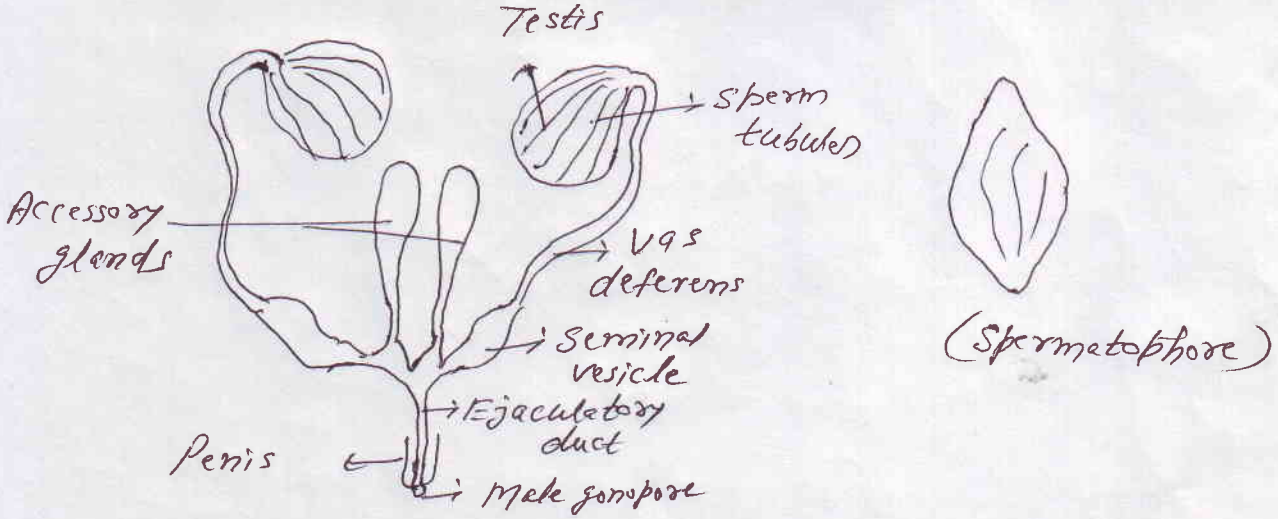
(a) Intercerebral cells of Brain → These cells Secrete BH. It activates the Corpora cardiaca

(b) Corpora Cardiaca → These Secretes PTTH which Stimulates the Prothoracic gland.

(c) Prothoracic gland → It Secretes Ecdysone. This hormone is known to trigger moultings. It is also responsible for pupation and initiation of adult characters.

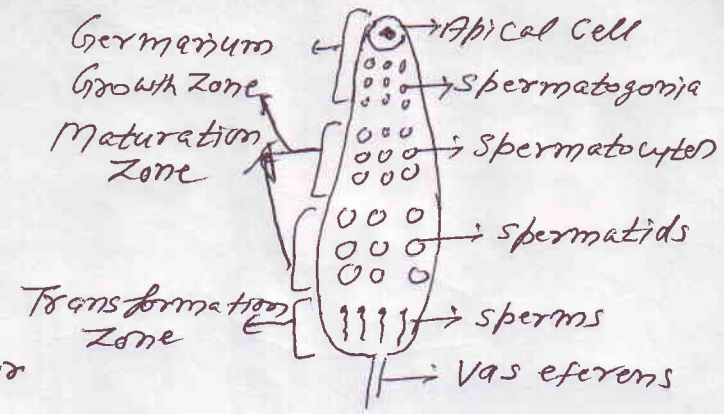
(d) Corpora allata → These secrete JH. This hormone regulates morphogenesis that is development of the larva into adult through pupal stage. It also maintains larval characters after each moult.

Q.10. Describe Male reproductive System & Reproduction in insects:



(Male Reproductive System)

- Cockroach is unisexual & sexual dimorphism is well developed. They perform sexual reproduction.
- Male reproductive system consists of following organs:



(a) Testes → These are 6 pair and contains sperm tubules. Each sperm tubule consists of apical cell & germarium. There are mainly three zones → Growth, maturation & transformation.
- In sperm tubules, sperms are produced by spermatogenesis.

(b) Vas deferens → These are 6 pair, formed by the union of Vasa efferentia. They conduct the sperms into seminal vesicle.

(c) Seminal vesicle → These are 6 pair and sac like. They store the sperms temporarily. They secrete seminal fluid which nourishes the sperms and also activates them for further movement.

(d) Ejaculatory duct → It is single, formed by the fusion of two seminal ducts. It passes through penis and opens outside through male gonopore.

(e) Penis → It is muscular and transfers the sperms into female reproductive system.

(f) Accessory glands → These are one pair. These activate sperms and are helpful in the formation of spermatophore. These stimulate female for oviposition.
- Spermatophore → It is gelatinous capsule which stores sperms. These are released to female reproductive system.

Q.11. Write about insects as vectors of diseases and their control:

Insects as Vectors of diseases & their Control

(1) Female Anopheles → It is vector of malarial parasite.
Disease → Malaria, Host - Man, Causative agent → Plasmodium (Protozoan)
- Control → Elimination of breeding places. Destruction of eggs, larvae, pupae and adults. Spray of oil on stagnant water. Use of insecticides. Use of larvivorous fishes. Personal Protection.

(2) Female Aedes → It is vector of Dengu fever.
Disease → Dengu, Host - Man, Causative agent → Dengu virus
- Control → Same as that of Anopheles

(3) Female Culex → It is vector of Elephantiasis.
Disease → Filaria, Host → Man, Causative agent → Wuchereria (Nematode).
- Control → Same as that of Aedes.

(4) Tse-Tse fly (Glossina) → It is vector of Sleeping sickness.
Disease → African sleeping sickness, Host → Man
Causative agent → Trypanosoma gambiens (Protozoan)
- Control → Eradication of bushes. Spray of DDT. Injection of Suramin (Antrypol).

(5) Bug (Triatoma) → It is vector of trypanosomiasis/Chagas
Disease → Chagas, Host - Children
Causative agent → Trypanosoma cruzi (Protozoan)
- Control → Use of insecticides to kill the bugs.

(6) Tabanus fly → It is vector of Surra disease.
Disease → Surra, Host → Horse, Camel, etc.
Causative agent → Trypanosoma evansi (Protozoan)
- Control → Burning of waste meterials. Smoking. Spray of insecticides. Destruction of eggs in ponds.

(7) Sand fly (Phlebotomus) → It is vector of Kala-Azar.
Disease → Kala-Azar, Host → Man
Causative agent → Leishmania donovani (Protozoan)
- Control → Removal of dump bricks & stones. Use of insecticides.