

B.Sc. 5th semester Paper 2nd
(Diversity of Chordates and Comparative Anatomy)

Question1: Write fundamental Characters of chordata.

Answer:

Fundamental Chordate Characters

The chordates are a group of animals that possess a set of fundamental characters, which are present at least at some stage of their life cycle. These characters help in the identification of chordates and are common to all members of the phylum.

1. Notochord

- A flexible, rod-like structure present in the embryo and usually replaced by the vertebral column in adults (except in some lower chordates).
- It provides support and acts as a backbone during the early stages of life.

2. Dorsal, Hollow Nerve Cord

- A hollow nerve cord located on the dorsal side of the body, above the notochord.
- It develops into the brain and spinal cord in higher chordates.

3. Pharyngeal Gill Slits

- Slits present in the pharynx, used for respiration in aquatic forms and for other functions in some terrestrial forms (e.g. filtration, feeding or voice production).
- Help in exchange of gases and filter food particles.

4. Endostyle or Thyroid Gland

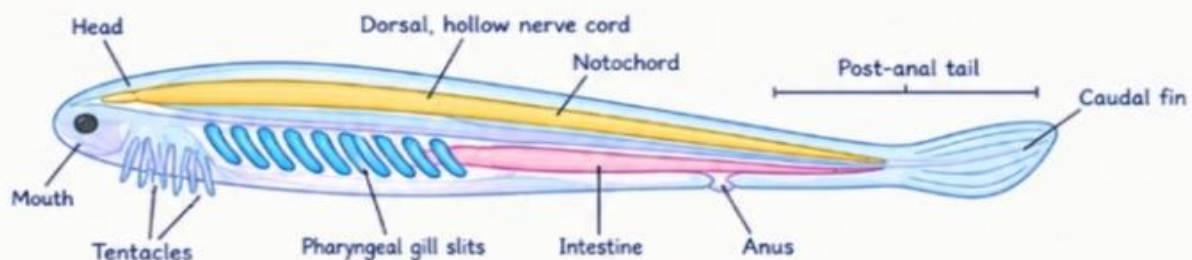
- An endostyle (which later becomes the thyroid gland) is present in the pharynx, involved in the secretion of iodine-containing mucus and in iodine metabolism.
- Later modified into the thyroid gland in higher chordates.

5. Post-Anal Tail

- A tail present beyond the anus, used for locomotion.
- Helps in swimming and provides stability.

6. Bilateral Symmetry and Triploblastic Body

- The body is bilaterally symmetrical (left and right halves are mirror images), which helps in directional movement.
- The body is triploblastic, i.e., made up of three germ layers – ectoderm, mesoderm and endoderm, which give rise to different organ systems.



Question 2: Write General Characters of Hemichordates.

Answer: General Characters of Hemichordates

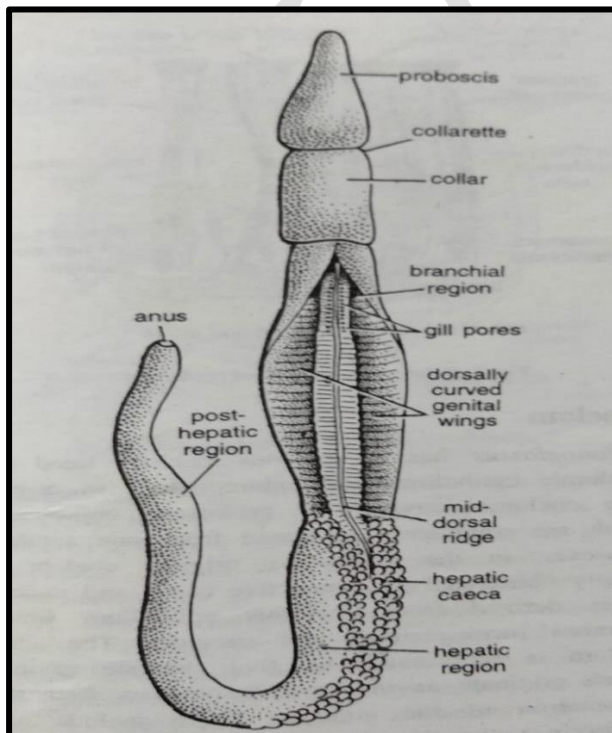
1. Marine solitary or colonial mostly tubicolous.
2. Body soft, fragile, vermiform, unsegmented bilaterally symmetrical and triploblastic.
4. The body is divisible into proboscis, collar, and trunk.
5. Body wall with a single-layered epidermis with mucous glands. No dermis.
6. Coelom enterocoelous, divisible into protoel, mesocoel and metacoel.
7. Buccal diverticulum, earlier considered as the notochord, present in the proboscis.
8. The alimentary canal is a straight, complete, or U-shaped tube.
9. Dorso-lateral pharyngeal gill-slits, when present, one to several pairs. Ciliary filter feeders.
10. Simple, open, and well-developed circulatory system, including a dorsal heart and 2 longitudinal vessels, one dorsal and one ventral.
11. Excretion by a single glomerulus situated in the proboscis.
12. Primitive type nervous system consisting mainly of subepidermal nerve plexus. Dorsal collar nerve cord hollow.
13. Reproduction is mainly sexual. Sexes usually separate. Gonads one to several pairs.
14. External fertilization in seawater.
15. Development direct or indirect with a free-swimming tornaria larva.

.Examples: *Balanoglossus*, *Saccoglossus*, *Rhabdopleura*, *Atubaria*, *Dendrograptus*.

Question 3: Write Morphology of Balanoglossus.

Answer: External Morphology

Divisions of the Body: The body is long and is divided into 3 parts.



1. Proboscis: It is club shaped structure. It is at the anterior end of the body. Its body wall is muscular. It encloses a coelomic cavity called proboscis coelome. In this proboscis

stomach, Heart, pericardium and glomerulus are present. The posterior end of proboscis is called neck. It connects proboscis with collar. Below this neck a pre-oral ciliated structure is present. It will test the

2 Collar: It is the middle part. It is a short part. In between collar and proboscis ventrally a big mouth is present. It is permanent opening. Collar contains two coelomic cavities.

3 Trunk: It is an elongated, posterior part-The body wall is folded hence it gives wrinkled appearance to the body. This trunk is divided into 3 parts.

a) Branchio genital region: This is the first part of the trunk. It includes gills and gonads hence it is called branchio-genital region.

b) Hepatic region: In this part hepatic caecae are seen hence it is called Hepatic region.

c) Caudal region: This is the posterior part of the body. At its tip anus is present. The body of this animal is covered by ciliated epidermis. This animal will make burrows in the sand with the help of proboscis and collar.

Question 4: Explain Ciliary feeding in Balanoglossus.

Answer: Ciliary feeding in Balanoglossus

Balanoglossus shows ciliary feeding, in which food particles are collected from seawater with the help of cilia and mucus. Water containing suspended food particles enters through the mouth. Cilia lining the buccal cavity and pharynx create a water current. Food particles get trapped in mucus secreted by the pharyngeal epithelium. The ciliary movement carries the mucus-bound food towards the oesophagus. Water passes out through the gill pores, while the food enters the digestive tract.

Water + food → mouth → cilia & mucus trap food → oesophagus → digestion; water → gill pores.

Question 5: Enumerate general characters of Cephalochordata

Answer: General Characters of Cephalochordata

1. Marine, widely distributed in shallow waters.
2. Mostly sedentary and buried with only anterior body end, projecting above bottom sand.
3. Body small, 5 to 8 cm long, slender, fish-like, metameric and transparent.
4. Head lacking. Body has trunk and tail.
5. Paired appendages lacking. Median fins present.
6. Exoskeleton absent. Epidermis single-layered.
7. Muscles myotomes, dorso-lateral, segmented into myotomes.
8. Coelom enterocoelous.
9. Notochord rod-like, persistent, extending from rostrum to tail.
10. Digestive tract complete. Filter feeders.
11. Respiration through general surface. No special organs for respiration present.
12. Circulatory system well developed, closed and without heart and respiratory pigment..
13. Hepatic portal system developed.
14. Excretion by protonephridia with solenocytes.
15. Nerve cord dorsal, tubular, without ganglia and brain.

Example : Branchiostoma

Question 6: Describe the morphology of Branchiostoma.

Answer: Morphology of Branchiostoma

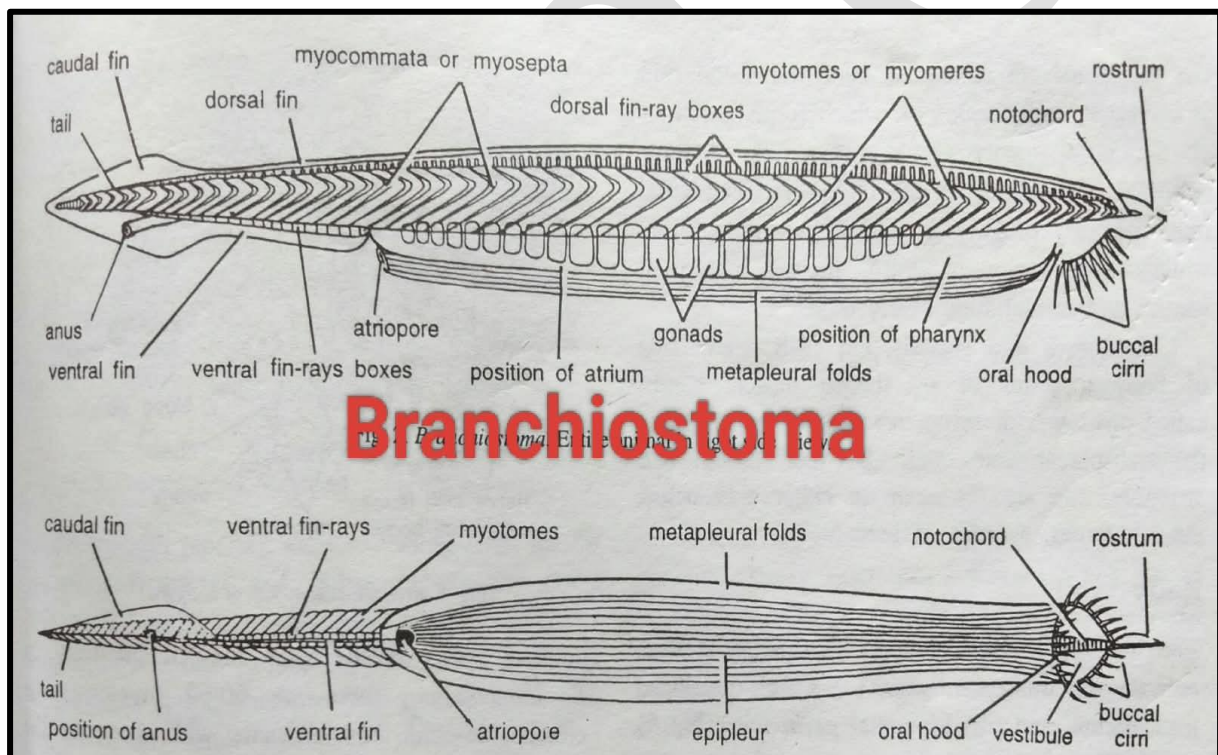
Shape, Size and colour:- It is small elongated narrow and fish-like animal 5 to 8 cm in length. Body is whitish, somewhat translucent, laterally compressed and pointed at both the ends.

Division of body: A true head is degenerate and absent. The body is divisible only in two regions. The anterior region constitutes the trunk and a much shorter postanal posterior region is the tail. The anterior end of trunk projects in front as a pointed snout or rostrum.

Apertures :- the trunk bears three openings: mouth, atriopore and anus. Mouth is a very wide, bordered by the free margin of oral hood. Atriopore is a small mid-ventral rounded aperture, laying just in front of the ventral fin.

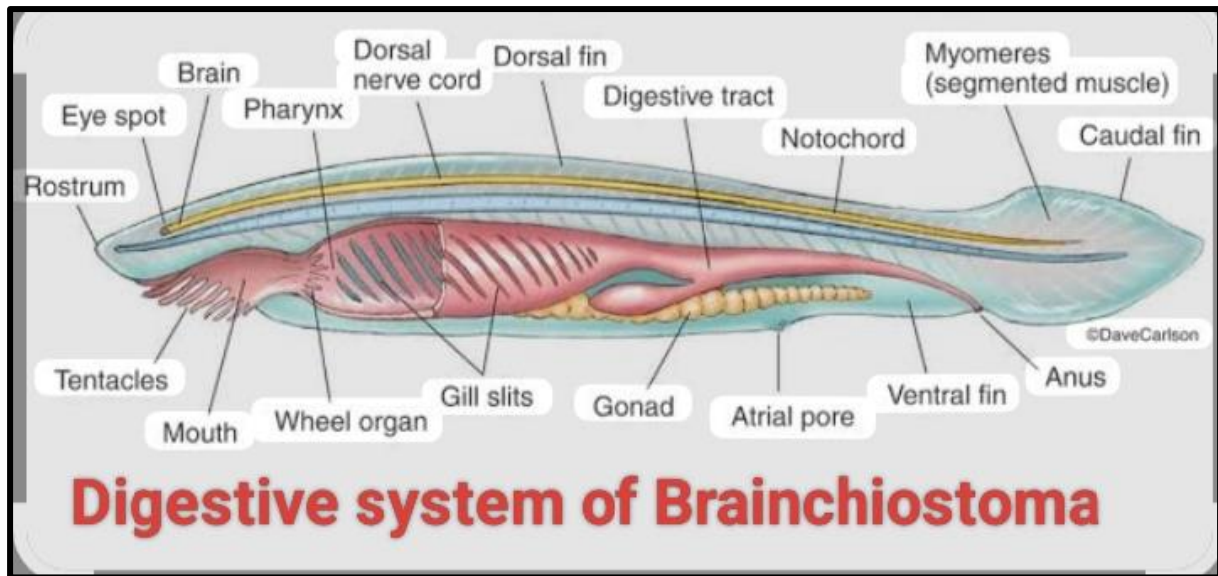
Fins and folds:- Branchiostoma bears three longitudinal median or unpaired fins: dorsal, caudal and ventral.

Myotomes and gonads:- On each lateral side of body a series of shaped muscle bands, called myotomes or myomeres. Between mouth and atriopore, can also be seen on either side below the myotomes, a series of gonads.



Question 7: Draw a well labelled diagram of Digestive system of branchiostoma.

Answer:



Question 8: Write short note on Endostyle of Branchiostoma.

Answer: Endostyle of Branchiostoma

The endostyle of Branchiostoma is a shallow, ciliated, and glandular groove located along the mid-ventral floor of the pharynx. It serves as a vital component of the animal's filter-feeding mechanism and represents a crucial evolutionary link to higher vertebrates.

Function in Feeding : Branchiostoma is a microphagous filter feeder. The endostyle coordinates with other pharyngeal structures to trap and move food.

Mucus Secretion: The four pairs of glandular bands continuously discharge a heavy stream of sticky mucus.

Sheet Formation: The lateral ciliated tracts beat their cilia upward, driving this mucus up the lateral walls of the pharynx, creating a mucus sheet.

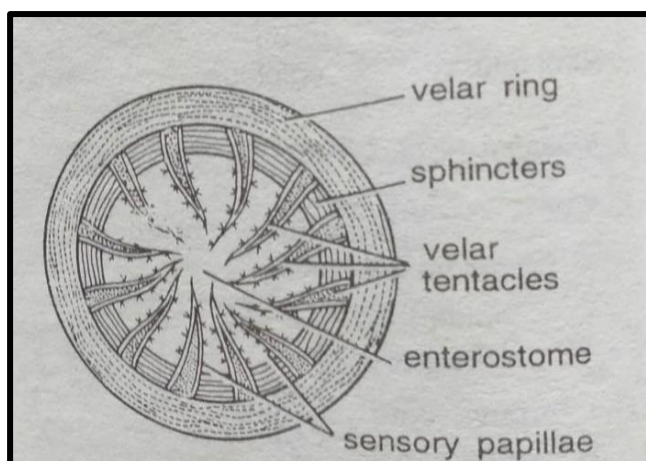
Food Trapping: As a water current enters the mouth, plankton, diatoms, and organic particles get entangled in this sticky mucus net.

Conveyance to Gut: The mucus-laden food sheet is pushed further upward to the dorsal epipharyngeal groove. From there, the cilia roll the food into a continuous cylinder and drive it backward into the esophagus and intestine for digestion.

Question 9: Write a note on Wheel Organ of Amphioxus.

Answer: Wheel Organ of Amphioxus.

The wheel organ is the specialized epithelium in the roof and the sides of the adult amphioxus oral cavity. Amphioxus holds a wheel organ which is also known as the rotatory organ or muller's organ in the vocal hood. It produces a whorling liquid flow. Wheel organ borders the oral epithelium properly. - Amphioxus holds a wheel organ which is also known as the rotatory gland or muller's gland in the vocal hood. It produces a whorling liquid flow to clean food from the mouth.



Question 10: Write short note on Oral hood of Branchiostoma.

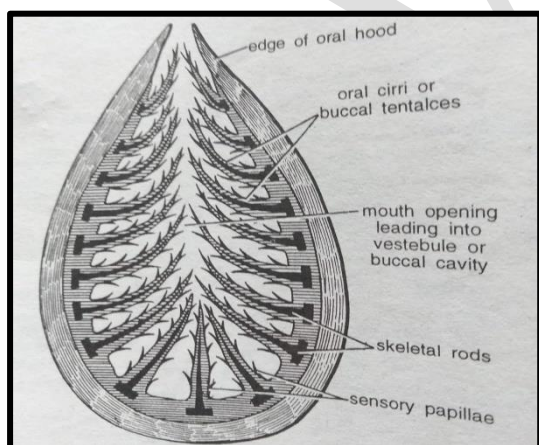
Answer: Oral hood of Branchiostoma

The oral hood is formed by the dorsal and lateral projections of the anterior end of trunk

(a) Buccal cirri-Free ventro-lateral edge or margin of oral hood is beset with 10 to 11 pairs of stiff, slender and ciliated oral or buccal cirri which bear sensory papillae. Their number increases with age. The buccal cirri and the edge of oral hood are internally supported by stiff, gelatinous skeletal rods. The buccal cirri form a sieve or filter to prevent entry of larger particle with food current.

(b) Vestibule- The oral hood encloses a large funnel-shaped cavity called buccal cavity or vestibule into which opens the mouth.

(c) Wheel organ- Basally, the epithelial lining of oral hood forms 6 to 8 pairs of finger-like folds formed by a ciliated groove bounded by a ciliated ridge. Collectively these form a wheel organ or rotatory organ or muller's organ.



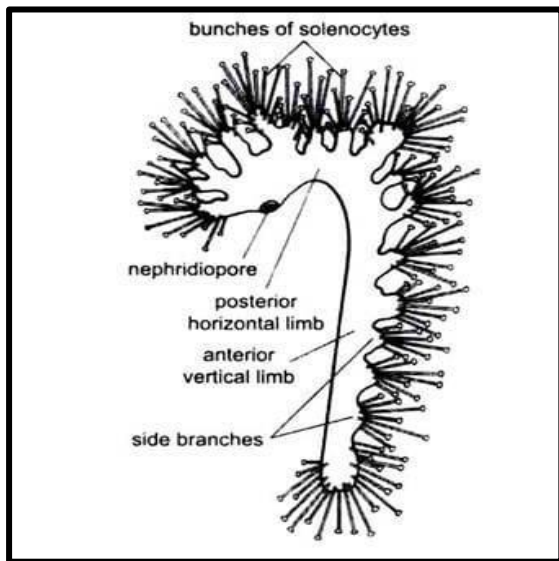
Question11: Write short note on Protonephridia of Amphioxus.

Answer: Protonephridia of Amphioxus

In Amphioxus protonephridia are excretory organs mainly located in the pharyngeal region.

Structure:

Simple, closed, ciliated sac like and thin walled ectodermal tubules present on pharyngeal wall on each gill. It is bent forming posterior horizontal and anterior vertical limb. Vertical limb is blind while horizontal limb opens into atrium through nephridiophore. Each protonephridium contains flame cells (solenocytes) with long flagella.

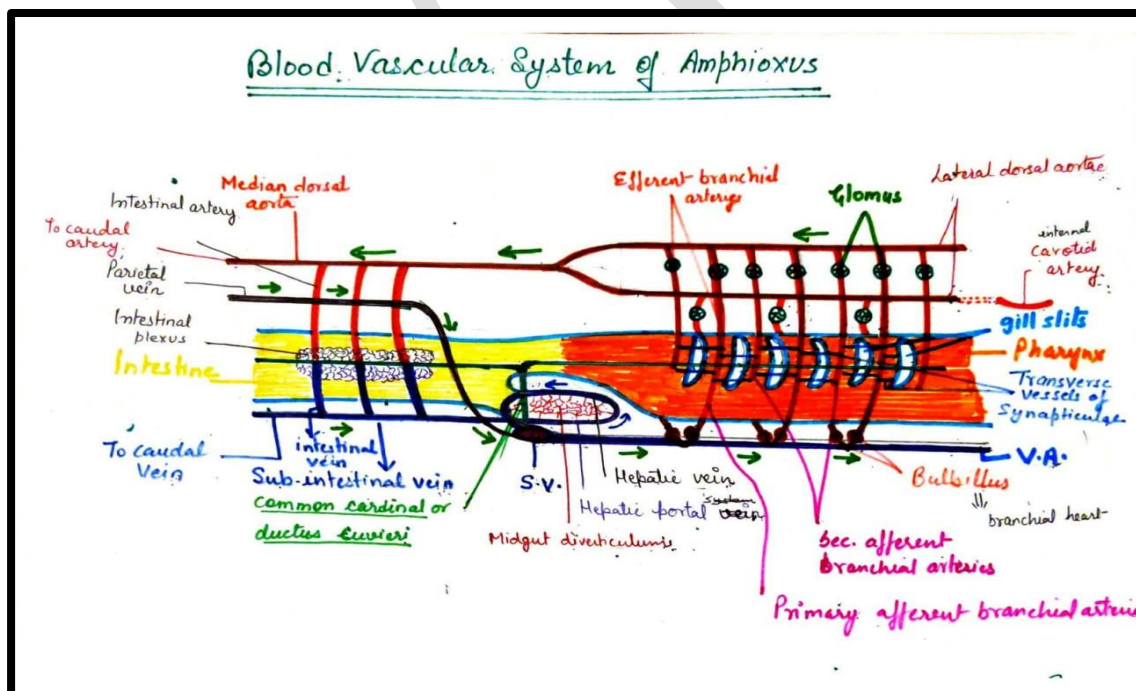


Functions:

1. Remove nitrogenous waste, mainly ammonia.
2. Help maintain water and ionic balance (osmoregulation).
3. Collect waste from the surrounding tissues and discharge it into the atrium.

Question 12: Draw a well labelled diagram Blood Vascular system of Amphioxus.

Answer:



Question 13: list the important characteristic features of sub phylum Urochordata.

Answer: General Characters of sub phylum Urochordata

1. Exclusively marine and cosmopolitan, found in all seas and at all depths.
2. Mostly sedentary, some free-swimming.
3. Size (0.25 to 250 mm), shape and colour variable.

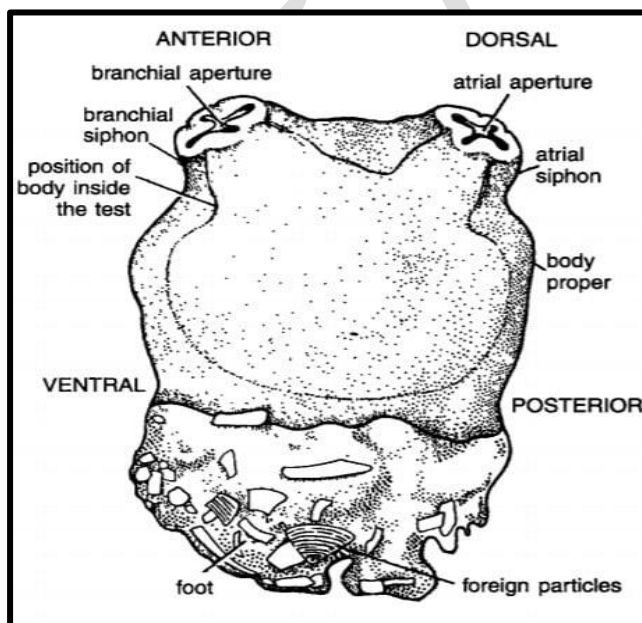
5. Adult body degenerate, sac-like, unsegmented, without paired appendages and usually without tail.
6. Body covered by a protective tunic or test composed largely of tunicine.
7. A terminal branchial aperture and a dorsal atrial aperture usually present.
8. Coelom absent. Instead, an ectoderm-lined atrial cavity present which opens to outside through atrial aperture.
9. Notochord present only in larval tail, hence the name Urochordata.
10. Alimentary canal complete. Pharynx large, with endostyle and two to several pairs of gill-slits. Ciliary feeders.
11. Respiration through test and gill-slits.
12. Blood-vascular system open. Heart simple. tubular and ventral.
13. Excretion by neural gland, pyloric gland and nephrocytes.
14. Dorsal tubular nerve cord only in larval stage, reduced to a single dorsal nerve ganglion in adult
15. Mostly hermaphrodite. Fertilization cross and external.
16. Development indirect including a free-swimming tailed larva .
17. Asexual reproduction by budding common.

Example Herdmania, doliolum, Pyrosoma, Salpa.

Question 14: Describe morphology of Herdmania.

Answer: Morphology of Herdmania

Herdmania is a marine, solitary ascidian belonging to Urochordata .



Body shape Size and Colour:

The body is sac-like, oval or pear-shaped and is attached to rocks or other hard surfaces by its basal end. It is generally a few centimetres long, though size varies among species. The animal is usually brownish, reddish or yellowish and may have a leathery appearance

Test

The body is covered by a thick test or tunic made mainly of tunicin, a cellulose-like substance.

Siphons

There are two openings:

Branchial or incurrent siphon – brings water into the body.

Atrial or excurrent siphon – expels water and wastes.

Attachment

The posterior/basal end remains attached to the substratum, while the siphons project freely.

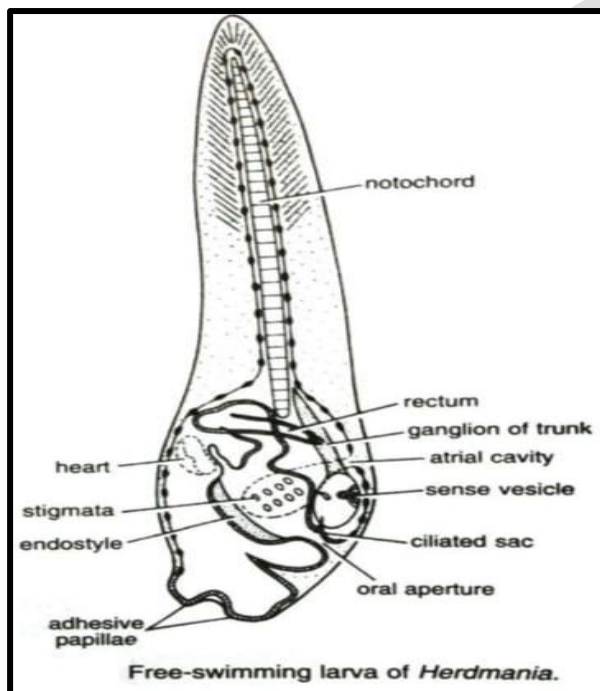
Notochord

The notochord is restricted to the larval tail and is absent in the adult.

Question 15: Write short note on Ascidian Tadpole Larva

Answer: Ascidian Tadpole Larva

It is the free-swimming larval stage of Ascidians (commonly known as Sea Squirts), which belong to the subphylum Urochordata (Tunicata).



External Features

Shape: It looks like a tiny frog tadpole with an elongated, oval body.

Size: It is very small, usually measuring about 3 mm in length.

Division: The body is clearly divided into an anterior Trunk (head) and a posterior Tail.

Test: The entire body is covered by a thin protective layer called the test or tunic.

Adhesive Papillae: The anterior end of the trunk contains three adhesive papillae used to attach to a substrate during settlement.

Metamorphosis: The larva undergoes an unusual process called Retrogressive Metamorphosis, where it loses advanced chordate features to transform into a degenerated, sedentary adult.

Question 16: Write a short note on Endostyle of Herdmania.

Answer: Endostyle of Herdmania

An endostyle is a longitudinal ciliated groove on the ventral wall of the pharynx which produces bodily fluid to accumulate food particles. It is found in urochordates.

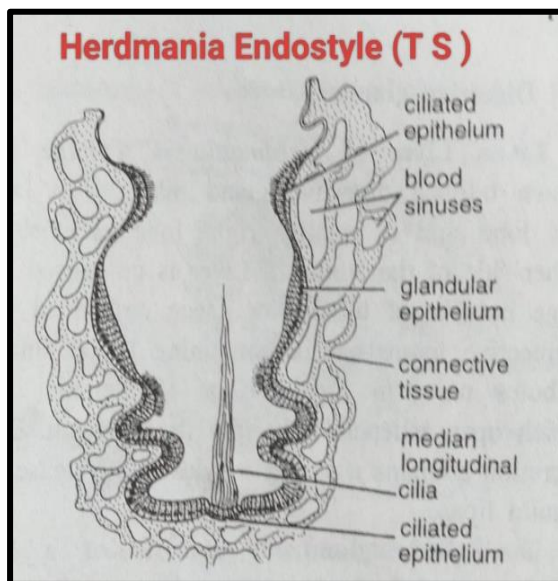
Functions

Mucus Secretion: Glandular cells within the endostyle produce sticky mucus.

walls, catching microscopic food particles brought in by the incoming water current. **Food**

Trapping: Cilia beat in a coordinated manner to spread the mucus sheet across the pharyngeal

Food Transport: The ciliary action moves the food-laden mucus cords upward toward the dorsal lamina and eventually backward into the esophagus for digestion.



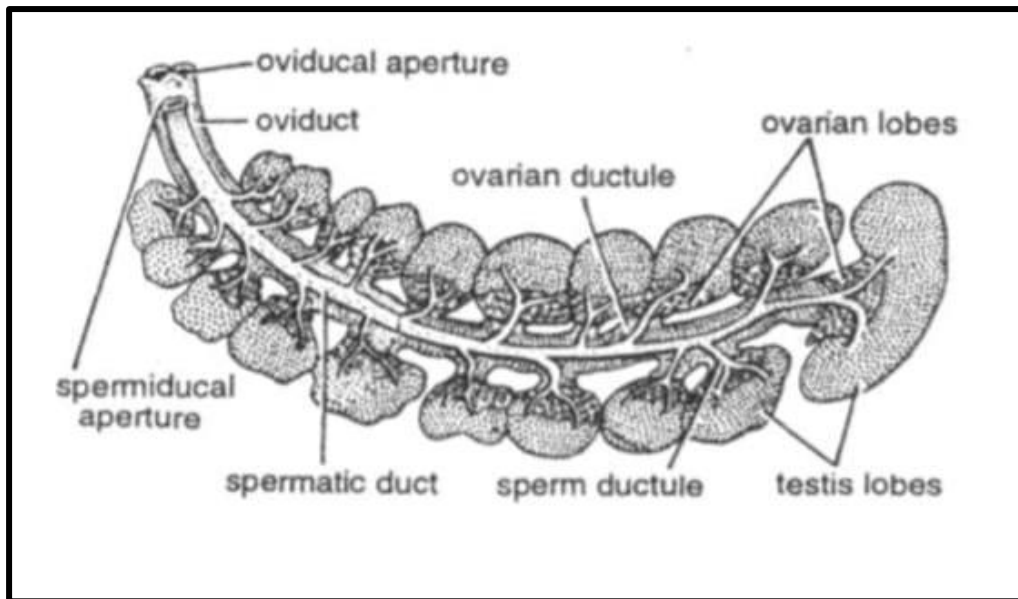
Question 17: Explain Reproductive System of Herdmania

Answer: Reproductive System of Herdmania

It is Hermaphrodite. It exhibits Protogyny. This ensures cross-fertilization.

Gonads: -Lt gonad lies in the intestinal loop and Rt lies above the pericardium. Gonads consist of 10-25 distinct lobes arranged in two rows with one median lobe at the proximal end. Each lobe is bisexual and has an outer large brick coloured Testicular part and an inner small pinkish Ovarian part.

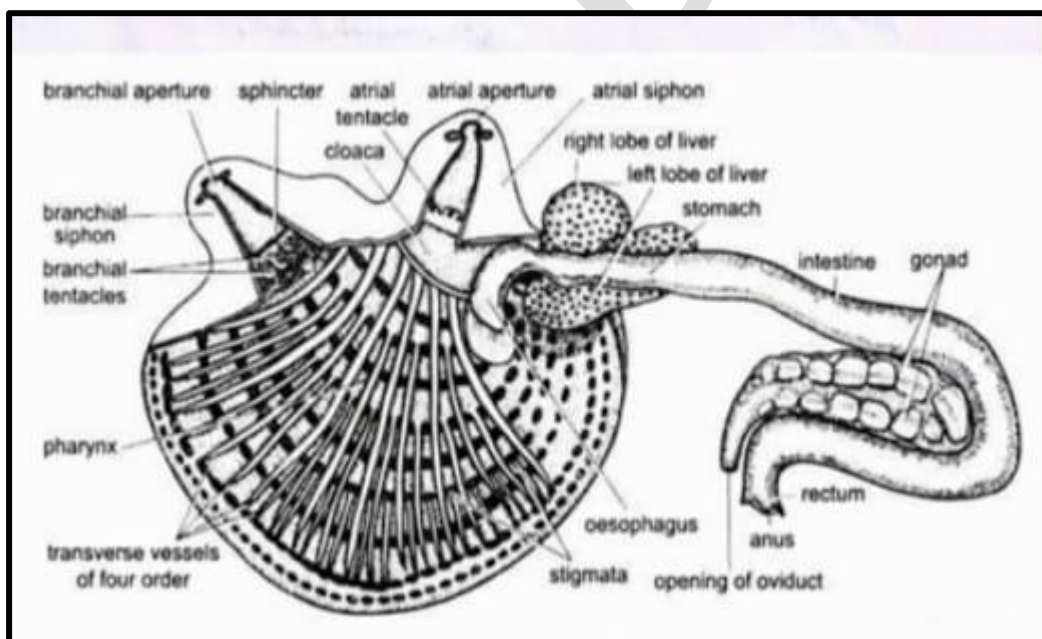
Gonoducts. Each gonad has two gonoducts, oviduct and spermatic duct, running along the central axis. The oviduct is a wider tube formed by the union of ovarian ductless one from ovarian zone of each lobe. It extends beyond the gonad for a short distance and opens into cloaca or dorsal atrial cavity, a little behind the anus, by an oviducal aperture bordered by four thick lips. The spermatic duct or vas deferens is a much narrower duct formed by the union of spermatic ductules one from testicular zone of each lobe. It runs along the inner (branchial) side of the oviduct and opens independently into cloaca by a spermiducal aperture a little behind the oviducal aperture. Both the gonoducts are lined by cilia internally.



Question 18: Explain digestive System of Herdmania.

Answer: Digestive System of Herdmania

The digestive system of Herdmania consists of a complete, U-shaped alimentary canal and two major digestive glands: the liver and the pyloric gland



Alimentary canal

- 1. Mouth:** The mouth lies at the top of branchial siphon, which is designated as the anterior end of the body. It is guarded by four lips of the test. The mouth leads into a branchial siphon.
- 2. Buccal Cavity:** A short, tubular passage leading inward from the mouth.
- 3. Pharynx (Branchial Sac):** A large, bag-like, highly vascular structure containing numerous gill slits and branchial tentacles that filter food particles.
- 4. Oesophagus:** A narrow tube connecting the pharynx to the stomach.
- 5. Stomach:** A thin-walled chamber where primary enzymatic digestion takes place.
- 6. Intestine:** A U-shaped loop where digested food is absorbed.

7 Rectum: The terminal straight part that holds waste material.

8. Anus: Opens into the atrial cavity near the atrial siphon to expel wastes.

Digestive Glands

Liver (Hepatic Gland): A large, bilobed dark brown gland attached to the stomach, secreting digestive juices containing amylase, protease, and lipase enzymes.

Pyloric Gland: An extensively branched network of tiny tubules embedded in the walls of the stomach.

Food, Feeding and Digestion

Herdmania is a filter feeder. Cilia move a continuous water current carrying microscopic algae, diatoms, and protozoans into the body. Food is trapped in mucus within the pharynx, routed to the stomach, broken down by liver enzymes, and absorbed in the intestine.

Question 19: Write short note on Retrogressive Metamorphosis.

Answer: Retrogressive Metamorphosis

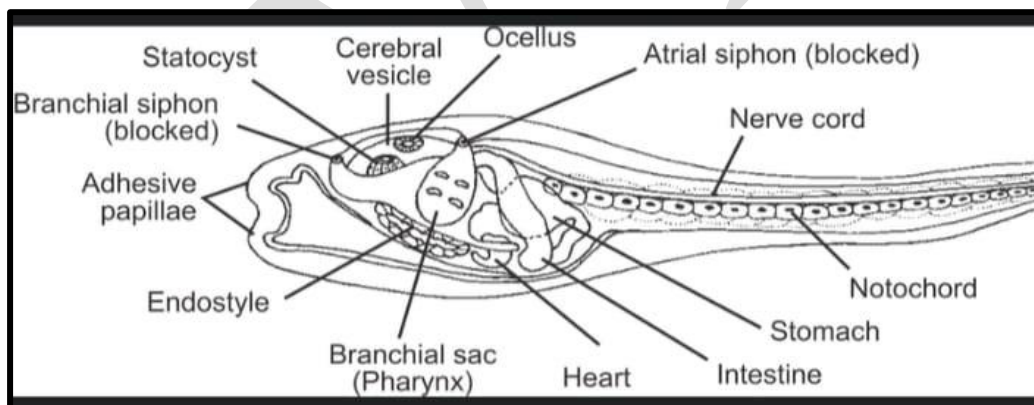
Retrogressive metamorphosis is a developmental process where an active, complex larval form transforms into a simpler, degenerative, or sessile adult. Instead of advancing in complexity, the organism loses its specialized or advanced structural features during the transition.

Features

Advanced Larva: The juvenile stage is free-swimming and highly developed.

Degenerative Adult: The mature form becomes fixed to a surface and loses major organs.

Evolutionary Reversal: Complex traits disappear because they do not suit a sedentary lifestyle.



Question 20: Write short note on Craniata.

Answer: Craniata

Craniata is a group of chordate animals that are defined by the presence of a skull or cranium protecting the brain. They possess a well-developed head region and a distinct brain and sense organs.

Characteristics of Craniata

1. Cranium is present and protects the brain.
2. Brain and sense organs are well developed.
3. Notochord is present at least during embryonic development; in most vertebrates it is replaced partly or completely by the vertebral column.

4. Dorsal hollow nerve cord develops into the brain and spinal cord.
5. Pharyngeal gill slits are present at some stage of development.
6. Endoskeleton is well developed, made of cartilage and/or bone.
7. Usually possess paired sense organs and paired appendages.
8. Circulatory system is generally closed, with a ventral heart.

Examples: Fishes, amphibians, reptiles, birds and mammals.

Question 21: Write General Characters of Class Amphibia.

Answer: General Characters of Class Amphibia

1. These can live both on land and in water.
2. They are ectothermic animals, found in a warm environment.
3. Their body is divided into head and trunk. The tail may or may not be present.
4. The skin is smooth and rough without any scales, but with glands that make it moist.
5. They have no paired fins. Unpaired fins might be present.
6. They have two pairs of limbs for locomotion.
7. They respire through the lungs and skin. Gills might be present externally in some adults.
8. The heart is three chambered.
9. The kidneys are mesonephric. The excretory material includes ammonia and urea.
10. They possess ten pairs of cranial nerves.
11. The lateral line is present during their development.
12. The sexes are separate and fertilization is usually external. However, in salamanders, the fertilization is internal.
13. Development is indirect with metamorphosis.
14. Breeding occurs in water. The copulatory organs are absent in males.

◀ Example: Frogs, Salamanders.

Question 22: Give an account Neoteny of in Amphibians.

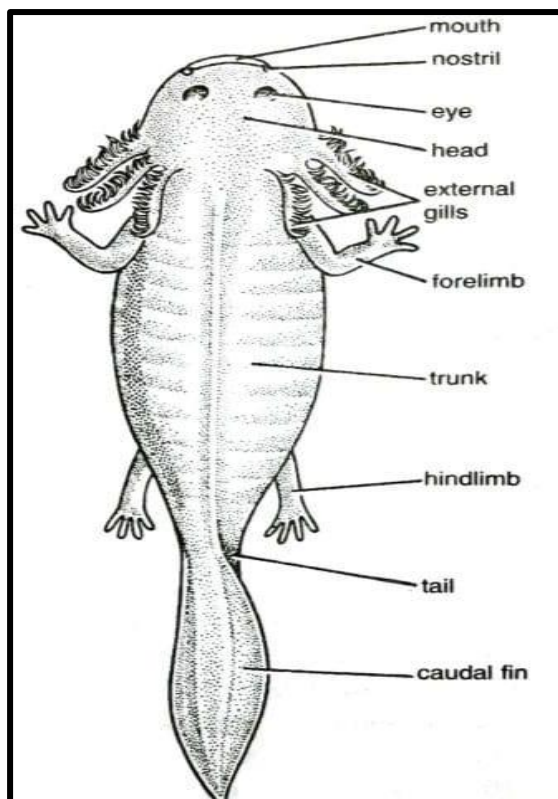
Answer: Neoteny

Neoteny in amphibians is the biological process where an organism reaches sexual maturity while still retaining its juvenile or larval physical features.

Types

1. Partial Neoteny
2. Total/Permanent Neoteny

Axolotl (*Ambystoma tigrinum*): The most famous example, a Mexican salamander that keeps its feathery external gills and aquatic lifestyle as an adult.



Cause

Environmental Triggers: Lack of iodine in the water or thyroid-stimulating signals can prevent normal hormonal transitions. High altitudes or cold climates also favour staying in the smaller, aquatic larval form

Evolutionary Advantage: It allows species to survive and reproduce in permanent bodies of water. When terrestrial conditions are too harsh or lack sufficient food resources.

Question 23: Explain Paedogenesis.

Answer: Paedogenesis

Paedogenesis is the process of reproduction by an organism without attaining physical maturity. It is discussed within developmental biology. Paedogenesis may be described as the attainment of sexual maturity at the larval or juvenile stage of an organism. This condition often happens when the thyroid gland fails to produce enough thyroxine, the hormone required to trigger full metamorphosis. It occurs primarily due to climatic or environmental conditions like low temperatures, lack of iodine, etc.

Example: Amphibians and some **Insects**.

Question 24: Write general characters of Class Reptilia.

Answer: General Characters of Class Reptilia.

1. Reptiles means creeping
2. The body is divided into head, neck, trunk, and tail.
3. Limbs are clawed when present
4. Cold-blooded(poikilothermic)
5. Exoskeleton of horny scales, scutes or bony plates
6. Skin dry, cornified and non glandular
7. Skull is monocondylic

8. T-shaped interclavicle present
9. The heart is 3 chambered. However, crocodiles have a 4-chambered heart.
10. Reptiles do not have external ear openings. Tympanum represents ear
11. R.B.C. oval and nucleated
12. 3-chambered Cloaca present
13. Uricotelic excretion
- 14, Metanephric kidney
15. Cranial nerves 12 pairs (except snakes which have 10 pairs)
16. Sexual dimorphism present
17. Fertilisation internal

Example: Snakes, Crocodile, Turtle and Lizard.

Question25: Write short note on Biting apparatus of Poisonous Snake.

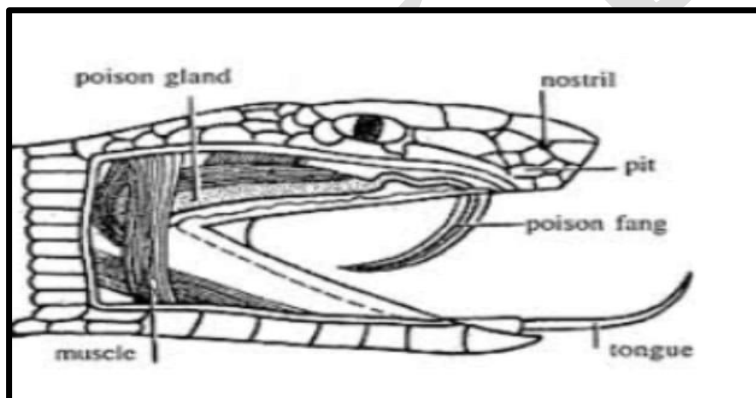
Answer: Biting Apparatus of a Poisonous Snake

The biting apparatus of poisonous snakes is a specialized arrangement of venom glands, venom ducts, and fangs that helps inject venom into the prey.

Parts

Venom glands – A pair of modified salivary glands that produce and store venom.

Venom ducts – Small tubes that carry venom from the venom glands to the base of the fangs.



Fangs – Long, sharp, hollow or grooved teeth used for injecting venom.

Muscles – Muscles around the venom glands contract and force venom through the ducts.

Opening of fangs – Venom enters the prey through the openings/grooves of the fangs.

Question26: What is Antivenom.

Answer: Antivenom

Antivenom (or antivenin) is a biological product containing venom-neutralizing antibodies. It is the only definitive antidote for significant systemic envenomation caused by venomous bites and stings (snakes, scorpions, spiders, and marine creatures. Antivenoms, or antivenins, are life-saving medicines used to treat snake bites. French physician **Albert Calmette** in the 1890s developed the first antivenom using horses. To produce antivenom, healthy and mature venomous snakes are first captured from the wild by trained experts who then “milk” the snakes to extract the venom. They immunise horses with increasing doses of venom over many weeks, allowing their immune systems to produce antibodies. Over time, the horses develop a robust immune response, producing antibodies that neutralise venom toxins. They

are produced by injecting small amounts of venom into animals, usually horses, which then produce antibodies as part of their immune response. These antibodies become antivenoms. The experts extract these antibodies from the horse's blood and purify and formulate them as antivenoms. The antibodies thus produced are very specific to the type of toxins injected.

Question 27: Describe Jacobson's Organ.

Answer: Jacobson's Organ

Jacobson's Organ is also known as the Vomeronasal Organ. It is a specialized chemoreceptor organ found in many vertebrates, especially in reptiles (snakes, lizards) and mammals (cats, dogs, rodents).

It was discovered by Ludwig Levin Jacobson in 1809. It is a pair of small, sac-like blind pouches located at the base of the nasal septum, just above the roof of the mouth.

- It is lined with sensory epithelium containing chemoreceptor cells.

Functions:

- 1. Pheromone Detection:** Its primary function is to detect pheromones - chemical signals released by one animal to affect the behavior of another of the same species.
- 2. Mate Recognition and Sexual Behaviour:** Helps in identifying a suitable mate, determining reproductive status, and initiating courtship and mating behavior.
- 3. Prey and Food Detection:** In reptiles, it helps to track prey and locate food by detecting chemical trails.

Question 28: Difference between Poisonous and Non- Poisonous snakes.

Answer: Difference between Poisonous and Non- Poisonous snakes

Difference between Non-poisonous Poisonous snakes:

Characters	Non-Poisonous Snakes	Poisonous Snakes
1. Physical features	Stout, dull coloured.	Slender, brightly coloured
2. Head	Rounded or elliptical	Triangular or posterior broadened
3. Head Scales	Large	Small
4. Saliva	Non-toxic	Contains toxic peptides and enzymes
5. Fangs	Not present.	Present, hollow like hypodermic needles
6. Teeth	several small teeth	Two long fangs.
7. Pupils	Rounded	Elliptical pupil
8. Anal Plate	Double row	Single row
9. Tail	Not much compressed, rounded	Compressed
10. Ventral belly plates	Small, never extends across the belly	Broad and always extended across the entire width of the belly
11. Bite mark	Row of small teeth	Fang Mark
12. Family	Boidae, Uropeltidae, Xenopeltidae, Typhlopidae	Viperidae, Elapidae, Colubridae, Hydrophidae
13. Examples	<i>Oligodon arnensis</i> , <i>Dendrelaphis tristis</i> , <i>Ahaetulla nasuta</i> , <i>Zamenis longissimus</i>	<i>Bungarus caeruleus</i> , <i>Daboia russelii</i> , <i>Ophiophagus hannah</i> , <i>Naja naja</i>

Question 29: What is Migration?

Answer: Migration

Migration is the regular, seasonal movement of bird from one region to another and back, usually in response to changes in food availability, climate, breeding conditions, or habitat.

Types of Migration

Seasonal migration – Movement during particular season.

Breeding migration – Movement to suitable places for reproduction.

Feeding migration – Movement in search of abundant food.

Altitudinal migration – Movement between different elevations.

Causes of Migration

1. Shortage of food
2. Unfavourable temperature and climate
3. Breeding requirements
4. Search for suitable habitat
5. Avoidance of predators or harsh environmental conditions

Advantages Of Migration

Migratory birds avail the facility of better breeding and feeding ground. As a result of arrival at warm places from cold places, the birds get longer day time to search their food. By migration birds escape unfavourable conditions.

Examples: Flamingo, bar-headed goose, Siberian crane.

Question 30: Describe Dental Formula.

Answer: Dental Formula

A dental formula is a standard way to write the number and type of teeth in one side (or quadrant) of the upper and lower jaws of a mammal. It uses the letters I (incisor), C (canine), P (premolar), and M (molar). Dental formulaIn mammals, number of teeth varies in different species. However, surprisingly enough, number of teeth is constant and characteristic for every species. Therefore, number and kinds of teeth in a species of mammals can be represented by a sort of equation, which is called dental formula. Since two halves of each jaw are identical, only the teeth of one side are recorded. Those of the upper and lower jaws are separated by a horizontal line. Kinds of teeth are denoted by their initial letters i c pm and m, representing incisors, canines, premolars and molars. Number of teeth shown in the formula multiplied by 2 gives the total number of teeth in a species.

Question 31: Write types of Teeth.

Answer: Types of Teeth

1. Incisors: The front and center of the mouth (8 total in adults: 4 on top, 4 on bottom). Thin and flat with a sharp, straight edge. Bite into and cut food into smaller pieces. They also help support the lips and articulate speech sounds.



2. Canines: Next to the incisors at the "corners" of the dental arches (4 total in adults: 2 on top, 2 on bottom). Sharp, elongated, and pointy (resembling fangs). Grip and tear tough foods like meat and crunchy vegetables.

3. Premolars (Bicuspid): Behind the canines and in front of the molars (8 total in adults: 4 on top, 4 on bottom). Note: Children do not have premolars in their baby teeth. Larger than canines with flat surfaces and ridges. Crush and tear food into smaller, manageable portions.

4. Molars: At the very back of the mouth (12 total in adults, including 4 wisdom teeth). The largest and strongest teeth with broad, flat surfaces. Perform the final stages of chewing by thoroughly grinding food down so it is safe to swallow and digest

Question 32: Explain Dentition.

Answer: Dentition

Dentition refers to the number, arrangement, and types of teeth in an animal. Mammalian teeth are generally thecodont — embedded in sockets of the jaws. They are heterodont.

Incisors (I) – cutting and biting

Canines (C) – tearing

Premolars (P) – crushing

Molars (M) – grinding

The dental formula is used to represent the arrangement of teeth in one half of the upper and lower jaws.

Example — Human dental formula

$$= 2.1.2.3 / 2.1.2.3 \times 2 = 32 \text{ teeth.}$$

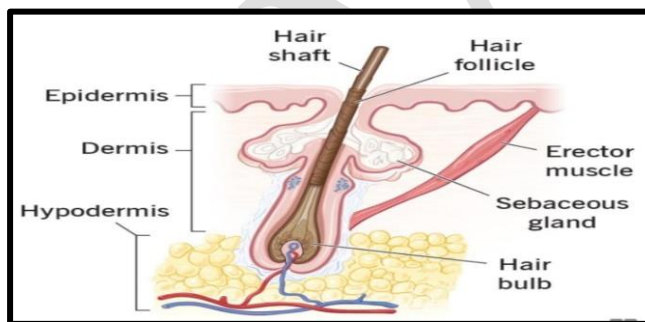
Question 33: What is Integumentary System? explain its functions.

Answer: Integumentary System

Integument is the outer covering of the body that protects an animal from its surroundings. The integumentary system is the body's outer covering, consisting of the skin (cutaneous membrane) and its accessory structures (hair, nails, and glands).

Functions of Integument

1. Offers physical protection against bacteria and pathogens.
2. Absorbs physical impact and helps heal cuts, abrasions, and other wounds.
3. Protects our body from infection and cushions it.
4. Protects us from sunburn and ultraviolet (UV) rays from the sun.
5. Secretes sebum, perspiration, and other bodily waste.
6. Keeps us cool by controlling our body's temperature.
7. Helps us sense cold, heat, and other feelings.
8. Synthesises vitamin D.



Question 34: Describe Visceral arches.

Answer: Visceral arches

Visceral arches (also called pharyngeal or branchial arches) are paired bars of bone or cartilage that support the throat wall and help attach the jaws to the skull in vertebrates. Vertebrates typically have seven pairs, numbered from front to back.

Structure of Typical Visceral Arches

1st Arch (Mandibular Arch): The front-most and largest arch. It splits into the dorsal palatoquadrate (upper jaw) and ventral Meckel's cartilage (lower jaw).

2nd Arch (Hyoid Arch): Supports the jaw suspension. It includes the hyomandibular, ceratohyal, and basihyal pieces.

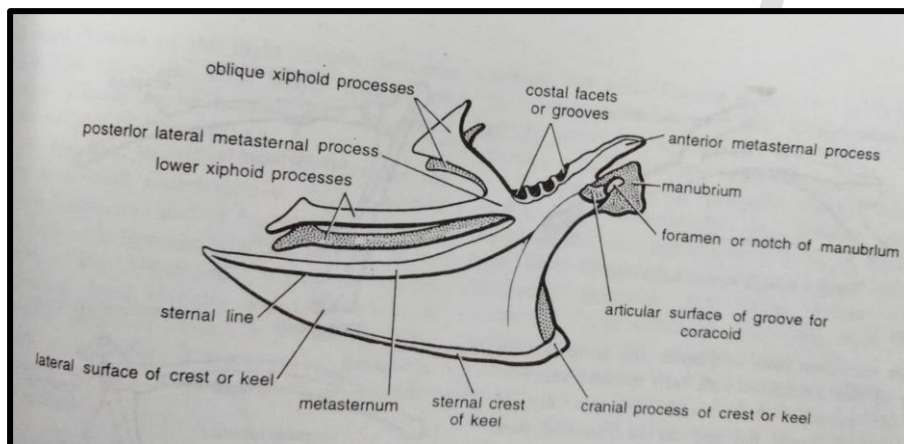
3rd to 7th Arches (Branchial Arches): These support the gills. Each standard branchial arch contains four basic cartilage segments: pharyngobranchial, epibranchial, ceratobranchial, and hypobranchial.

Question 35: Write short note on Sternum of Birds.

Answer: Sternum of birds

The sternum or breastbone is a broad, flat, unsegmented irregular or board shaped bone located in the ventral thoracic region. it is one of the most characteristic parts of endoskeleton of birds. it various components are as follows,-

- | | | |
|---------------------------|---------------------|---------------------|
| 1. Meta sternum | 2. Keel | 3. Manubrium |
| 4. Meta sternal processes | 5. Coastal surfaces | 6. Coracoid grooves |



Functions

- 1. Flight Anchor:** It provides a wide surface area for attaching the heavy muscles required to lift and propel the bird during flight.
- 2. Vital Organ Protection:** It forms a rigid floor over the thoracic cavity, protecting the heart, lungs, and internal organs from high pressure during flight.
- 3. Respiratory Aid:** During respiration, the sternum acts like a bellows. It moves downward and forward to change the volume of the internal air sacs, drawing air through the lungs.

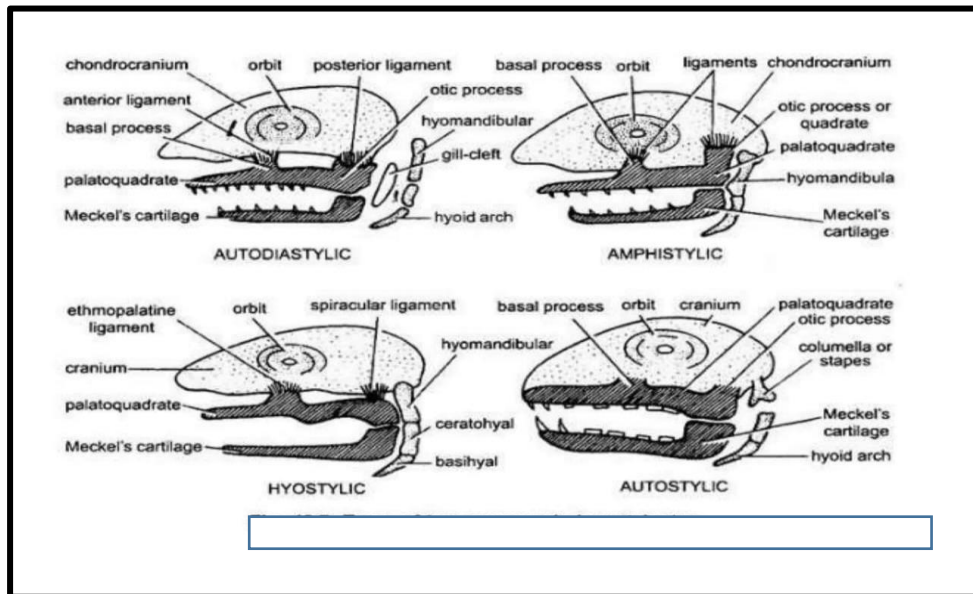
Question 36: Describe Jaw Suspensorium .

Answer: Jaw Suspensorium

Jaw suspensorium is the anatomical method by which the upper and lower jaws are attached to the skull in vertebrates.

Types of Jaw Suspension

- **Amphistylic:** The jaws attach to the skull at two points. Found in primitive sharks.
- **Hyostylic:** The upper jaw is loosely attached to the cranium, and the jaws are suspended primarily by the hyomandibula bone. Found in most modern bony fishes and sharks.
- **Autostylic:** The upper jaw fuses or binds directly to the skull without help from the hyomandibular bone. Found in lungfishes, amphibians, reptiles, and birds.
- **Craniostylic:** The upper jaw fully fuses into the braincase, and the lower jaw articulates directly with the squamosal bone. Former jaw joints (like the quadrate and articular) move into the middle ear to become hearing bones. Found in mammals.



Question 37: Write short notes on Palate.

Answer: Palate

The palate is the bony structure forming the roof of the mouth. It separates the oral cavity from the nasal passage and helps in feeding and breathing.

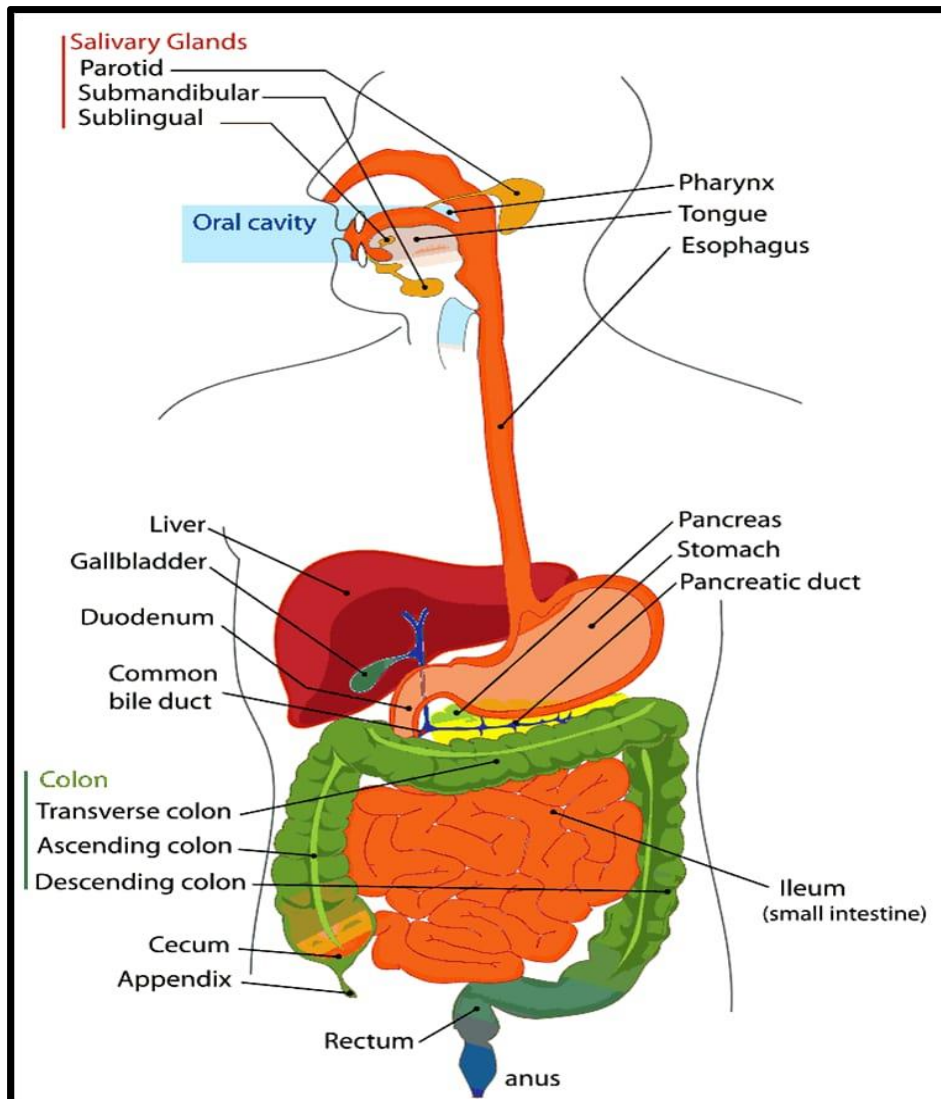
Types of palate in birds

Huxley in 1887 pointed out four types of palate in birds based on the arrangement and connection of the skull bones:

- 1. Palaeognathous or Dromaeognathous palate** – Found in ratites such as ostrich and emu. The vomer is large and joins the pterygoids and palatines.
- 2. Schizognathous palate** – Found in many primitive birds. The vomer is narrow and does not join the pterygoids.
- 3. Desmognathous palate** – Common in many modern birds. The palatines and pterygoids are strongly united with the skull.
- 4. Aegithognathous palate** – Characteristic of many passerine birds. The vomer is broad and the palatines are arranged in a characteristic way.

Question 38: Draw a well labelled diagram of Digestive system with Accessory digestive gland.

Answer: Digestive system with Accessory Digestive gland.



Question 39: Write short notes on glands of digestive system.

Answer: Glands of digestive system.

The digestive glands are specialized organs that secrete enzymes, acids, and fluids to break down complex food into simple, absorbable nutrients.

Salivary Glands: Located in the mouth, there are three pairs—parotid, submandibular, and sublingual. They secrete saliva containing the enzyme salivary amylase (ptyalin), which digests starch into sugar, and lysozyme, which kills bacteria.

Gastric Glands: Found in the inner lining of the stomach, these glands secrete gastric juice containing hydrochloric acid (HCl), mucus, and pepsin. HCl creates an acidic medium and kills germs, while pepsin breaks down proteins.

Liver: The liver is a reddish-brown largest internal gland of the body, located in the upper right abdomen. It secretes bile juice (stored in the gall bladder) which emulsifies fats into smaller droplets to aid digestion.

Pancreas: A mixed gland located behind the stomach. It secretes pancreatic juice containing powerful enzymes like trypsin (for proteins), lipase (for fats), and amylase (for carbohydrates) into the small intestine.

Intestinal Glands: Located in the walls of the small intestine (crypts of Lieberkühn and Brunner's glands). They secrete intestinal juice which completes the final breakdown of carbohydrates, proteins, and fats into simple sugars, amino acids, and fatty acids.

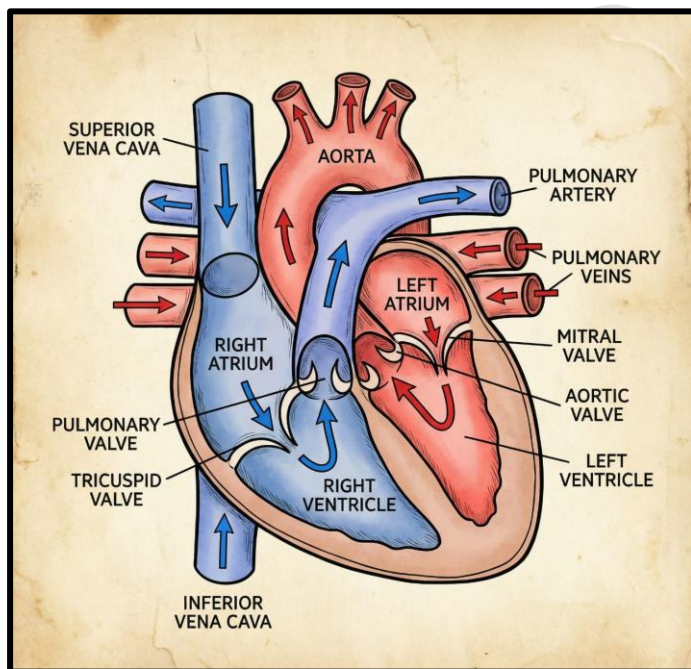
Question 40: Write short note on Gills.

Answer: Gills

Gills are respiratory organs found mainly in aquatic animals. They are richly supplied with blood vessels, providing a large surface for gaseous exchange. Oxygen from water diffuses into the blood, while carbon dioxide diffuses out. In fishes, gills are located on either side of the pharynx and are covered by the operculum. Gills are generally thin, moist and highly vascularised, making diffusion efficient.

Question 41: Draw a well labelled diagram of Mammals Heart.

Answer: Mammals Heart.



Question 42: Write short notes on Airbladder.

Answer: Air Bladder or Swim Bladder

A organ of bony fishes is a gas-filled pneumatic sac, called air bladder or swim bladder, lying dorsal to the digestive tract, directly beneath the vertebral column and mesonephric kidneys but outside coelom. Swim bladder does not occur in elasmobranchs.

Functions

- 1. Hydrostatic function:** Helps the fish maintain buoyancy and stay at a particular depth without continuously swimming.
- 2. Regulates specific gravity:** Changes in the amount of gas help the fish rise or sink in water.
- 3. Sound production:** In some fishes, it acts as a resonating chamber for producing sounds.

- 4. Audition:** In fishes with Weberian ossicles, vibrations from the air bladder can be transmitted to the inner ear.
- 5. Accessory respiration:** In some fishes, it can function as an accessory respiratory organ.

Question 43: What is Urogenital System.

Answer: Urogenital System

The urogenital system (also called the genitourinary system) is the combined organ system of the urinary system and the reproductive system.

Urinary System

This part removes liquid waste and keeps body fluids balanced.

Kidneys: Bean-shaped organs that filter blood and make urine.

Ureters: Thin tubes that carry urine from the kidneys to the bladder.

Bladder: A muscular sac that stores urine until it leaves the body.

Urethra: A tube that carries urine from the bladder to the outside of the body.

Reproductive System (Genital Tract)

This part handles sexual reproduction.

Male organs: Include the testes, sperm ducts, prostate, and penis. In males, the urethra also serves as a shared pathway for both urine and semen.

Female organs: Include the ovaries, fallopian tubes, uterus, and vagina.

Question 44: Explain types of Mammalian Uteri.

Answer: Types of Mammalian Uteri

1. Bicornuate Uterus: Y-shaped uterine horns that are separate at the upper end but fused near the lower end into a single body and one cervix.

Examples: Dogs, pigs, elephants, and whales.

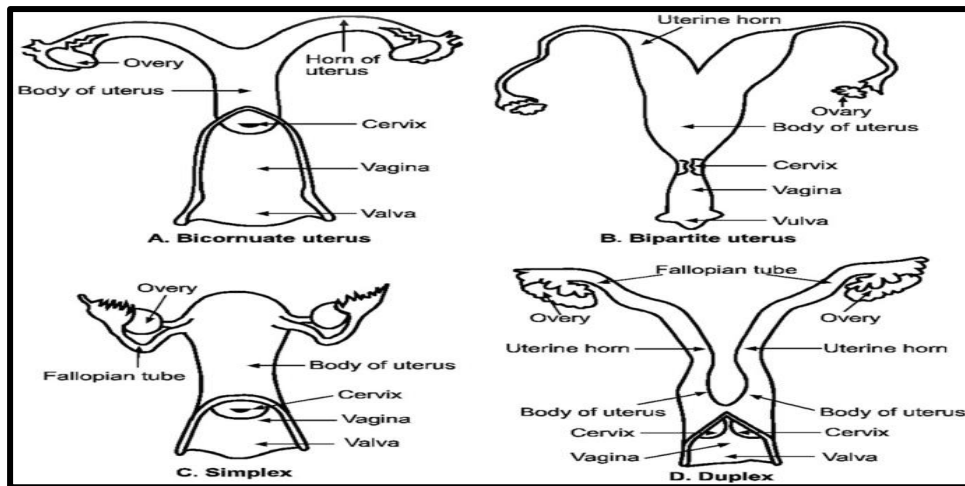
2. Bipartite Uterus: Two distinct uterine horns that share a single common cervix and a small body.

Examples: Ruminants (deer, cows, sheep), cats, and horses.

3. Simplex Uterus: A single, completely fused pear-shaped chamber with no separation between horns and a single cervix.

Examples: Higher primates, including humans and chimpanzees.

4. Duplex Uterus: Two completely separate uteri and two separate cervixes opening into the vagina.. **Examples:** Rodents (mice, rats), lagomorphs (rabbits, hares), and marsupials.



Question 45: Write types of kidney.

Answer: Types of Kidneys (Evolutionary Types)

1. Pronephros It is most primitive and basic type of kidney found in the embryos of all vertebrates, but functional only in adult primitive fishes (like hagfish) and tadpoles. It consists of a few segmented nephrons that open into the coelom.

2. Mesonephros

The intermediate type of kidney that replaces the pronephros. Functional adult kidney in amphibians (like frogs) and most adult fishes. It acts as a temporary embryonic kidney in reptiles, birds, and mammals. It contains more advanced, non-segmented nephrons with a Bowman's capsule.

3. Metanephros

The most highly evolved, complex, and efficient type of kidney.

Found in all adult reptiles, birds, and mammals (including humans). Composed of millions of highly specialized nephrons capable of highly concentrating urine to conserve water.

Question 46: Write cranial nerve of Vertebrates.

Answer: Cranial nerves of Vertebrates

Cranial nerves are a set of 12 paired nerves that connect your brain directly to your head, face, neck, and body.

12 Cranial Nerves

1. **CN I - Olfactory Nerve:** Controls your sense of smell.
2. **CN II - Optic Nerve:** Controls your vision.
3. **CN III - Oculomotor Nerve:** Moves your eyes and controls your pupils.
4. **CN IV - Trochlear Nerve:** Helps move your eyes down and out.
5. **CN V - Trigeminal Nerve:** Controls face feeling and chewing muscles.
6. **CN VI - Abducens Nerve:** Moves your eyes side to side.
7. **CN VII - Facial Nerve:** Controls facial expressions and taste on the front of your tongue.
8. **CN VIII - Vestibulocochlear Nerve:** Controls hearing and balance.
9. **CN IX - Glossopharyngeal Nerve:** Controls swallowing and taste on the back of your tongue.
10. **CN X - Vagus Nerve:** Controls organs in your chest and abdomen, plus speech and digestion.

11. **CN XI - Accessory Nerve:** Moves your neck and shoulders.
12. **CN XII - Hypoglossal Nerve:** Moves your tongue for speech.

Question 47: Write short note on Spinal Cord.

Answer: Spinal Cord

The spinal cord is a long, fragile cylinder of nerve tissue inside the backbone. It is about 45 cm long. It links the brain to the rest of the body. It handles body movement, feeling, and fast reflex actions.

Spinal Nerves (31 Pairs)

1. **Cervical (C1–C8):** Neck, arms, and breathing control.
2. **Thoracic (T1–T12):** Chest and upper body.
3. **Lumbar (L1–L5):** Lower back and legs.
4. **Sacral & Coccygeal (S1–S5, Co1):** Pelvis, feet, and tailbone area.

Functions

1. **Two-Way Signal Path:** Carries brain commands down to muscles and sensory data up to the brain.
2. **Reflex Center:** Processes quick survival responses without waiting for the brain.
3. **Coordination:** Helps control basic movement patterns like walking.

Question 48: Write short notes on Autonomic Nervous System.

Answer: Autonomic Nervous System

The autonomic nervous system (ANS) is the part of the nervous system that controls involuntary body functions—processes that happen automatically without conscious effort. It regulates things such as heart rate, blood pressure, breathing, digestion, sweating, pupil size, urination, and sexual responses. The ANS main divisions:

Sympathetic nervous system — the “fight or flight” system. It increases heart rate, dilates pupils and airways, and reduces digestive activity during stress or activity.

Parasympathetic nervous system — the “rest and digest” system. It slows the heart, promotes digestion, and helps conserve energy.

Question 49: Write short notes on Central Nervous System.

Answer: Central Nervous System

Central nervous system (CNS) is part of your nervous system. It consists of your brain and spinal cord. Your CNS collects information from your sensory nerves to process and respond to them. It regulates everything your body does.

Functions

Processing Information: Gathers sensory data from your eyes, ears, skin, and other organs to make sense of your surroundings.

Coordinating Movement: Controls every action you take, from walking and talking to blinking and breathing.

Regulating Body Functions: Manages automatic processes like your heartbeat, blood pressure, digestion, and body temperature. Central nervous system (CNS) is part of your nervous system. It consists of your brain and spinal cord. Your CNS collects information from your sensory nerves to process and respond to them. It regulates everything your body does.

Question 50: Write short note on hepatic portal system.

Answer: Hepatic portal system

The hepatic portal system is a network of veins that carries blood from the digestive organs to the liver. This system is crucial for processing nutrients and detoxifying harmful substances.

Hepatic Portal Vein: The main large vein that takes blood straight into the liver.

Contributing Veins: Smaller veins that collect blood from different organs:

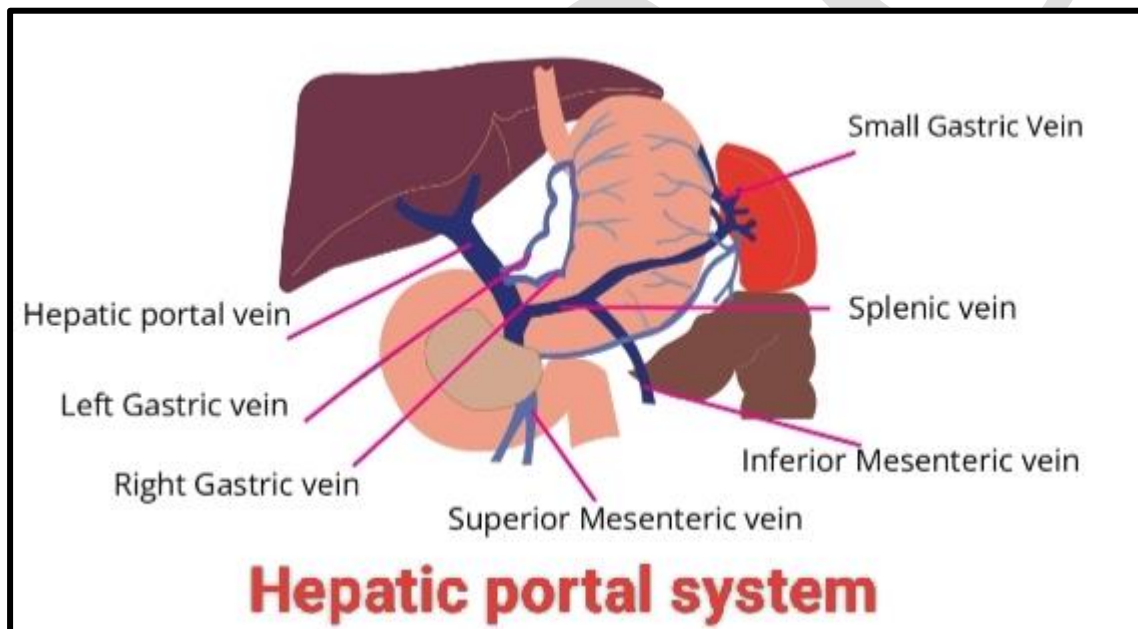
Gastric veins -from the stomach

Mesenteric veins -from the small and large intestines.

Splenic vein -from the spleen and pancreas

Functions

1. Metabolizes carbohydrates, proteins, and fats; stores glucose as glycogen
2. Synthesizes vital proteins and other compounds
3. Detoxifies drugs and other harmful substances
4. Removes bacteria and debris picked up from the intestines



Question 51: Write short note on synapses.

Answer: Synapses

The junction between two neurons is called a synapse. It is a specialized junction where transmission of information takes place between a nerve fibre and another nerve, muscle or gland cell. It is not the anatomical continuation. But, it is only a physiological continuity between two nerve cells.

Types of Synapses

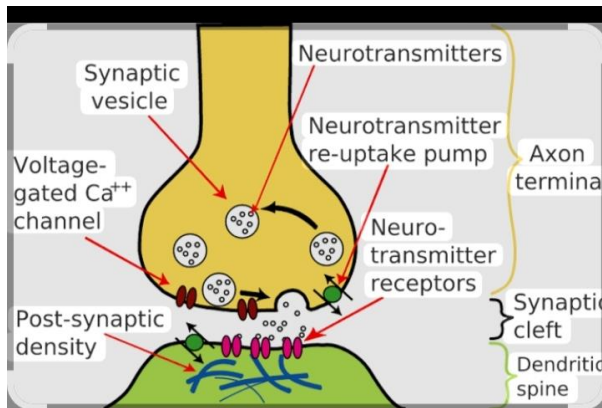
Chemical Synapse: The most common type; uses neurotransmitters to bridge the gap in a slower, one-way direction. When an impulse arrives, vesicles release chemicals into the cleft, which bind to receptors and open ion channels on the next cell.

Electrical Synapse: Connected by physical channel structures called gap junctions, allowing ions to pass directly and instantly between cells in either direction.

Function

Permits complex integration, amplification, or inhibition of nervous signals.

Coordinates all vital body movements, sensory processing, and reflex actions.



Question 52: What are Receptors? classify them.

Answer: Receptors

Receptors are defined as specialized structures found in the cell membrane. They are mainly composed of proteins, which bind to ligands and cause responses to the immune system. These receptors are found in various immune cells, including the B cells, T cells, stem cells and monocytes. Apart from the immune cells, receptors are present in other parts of the human body. The sense organs, including the eyes, ear, nose, tongue and skin are examples of

Classification of Receptors.

1. According to the type of stimulus

- i. Mechanoreceptors:** Touch, pressure, vibration, stretch Receptors in skin, muscles.
- ii. Thermoreceptors:** :Temperature, Warm and cold receptors in skin.
- iii. Chemoreceptors:** Chemicals, Taste buds, receptors for blood CO₂/O₂
- iv. Photoreceptors:** Light, Rods and cones of retina
- v. Nociceptors:** Tissue damage/painful stimuli, Free nerve endings

2. According to location:

Exteroceptors – detect stimuli from outside the body, e.g. touch and temperature receptors in skin.

Interoceptors (visceroceptors) – detect changes inside the body, e.g. receptors monitoring blood pressure.

Proprioceptors – detect position and movement of muscles and joints, e.g. muscle spindles.

Question 53: Write short note on Visual Receptors.

Answer: Visual Receptors

Visual receptors are specialized sensory receptors that detect light and help in vision. They are located in the retina of the eye.

Types of Visual Receptors

- 1. Rods:** Highly sensitive cells suited for dim-light, night (scotopic), and peripheral vision, providing black-and-white images. They contain the pigment rhodopsin.

2. Cones: Less sensitive cells responsible for sharp, daylight and color vision, concentrated heavily in the central fovea. They use iodopsin pigments divided into blue, green, and red sensitive types.

Structure of Photoreceptors

Outer Segment: Holds stacked membranous discs embedded with photopigments like rhodopsin or iodopsin.

Inner Segment: Contains vital metabolic machinery including mitochondria and ribosomes.

Cell Body: Houses the cell nucleus.

Synaptic Terminal: Passes chemical/electrical signals down to bipolar and horizontal cells.

Question 54: Write short notes on mullerian duct.

Answer: Müllerian Duct

The Müllerian duct, also called the paramesonephric duct, is an embryonic duct found in vertebrate embryos. It plays an important role in the development of the female reproductive system. It develops from the coelomic epithelium of the urogenital ridge. The duct grows caudally and runs parallel to the Wolffian (mesonephric) duct. The two Müllerian ducts eventually fuse in their posterior region in many vertebrates.

Functions

1. Provides the embryonic basis for development of the female genital tract.
2. The oviducts derived from it help in transport of ova.
3. The uterus provides a site for implantation and development of the embryo in mammals.