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## 1. BIODIVERSITY

### Part A

#### Choose the right answer :-

1. The theme of the world summit on environment held in Johannesburg in 2002 was - c) sustainable earth
2. The introduction of phylogeny in taxonomy was made by - b) Lamark
3. If two or more workers describe the same organism using different names it results in - a) homonyms
4. Which among the following is a pseudocoelomate ? - d) Nematoda
5. Five Kingdom concept does not include - b) viruses
6. Which among the following is considered 'a blood fluke' - a) Schistostoma
7. The head formation or cephalization happened for the first time in the Phylum - b) Annelida
8. Which among the following is considered as a connecting link between Annelida and Arthropoda  
Peripatus
9. The characteristic feature of echinoderms is the possession of - d) water vascular system
10. Acrania refers to - d) prochordates
11. The segmented body muscles in fishes are called as - a) myotomes
12. Which among the following is considered as a defeated group - a) amphibians
13. The amniotes are characterised by the presence of - c) egg membranes
14. Which among the following is not a character of mammals - b) right aortic arch
15. The infective stage of plasmodium is - d) merozoite
16. In earthworm the clitellum is present in segments - b) 14 to 17
17. The muscle fold found in the dorsal wall in the intestine of the earthworm is - b) Typhlosole
18. The chlorogogen cells on the wall of the intestine in earth worm is meant for - c) excretion
19. The uropygeal gland of pigeon are found - a) above the tail
20. The hollow bones of birds are called as - a) pneumatic bones

### Part B

#### Give very short answers.

##### 1. Define biosphere?

-The term 'biosphere' had been coined to highlight the interdependence of living and non-living world.

##### 2. Why do we consider Aristotle as the father of biological classification?

-He emphasized that animals can be classified according to their way of living, actions, habits and body parts. The insect orders like Coleoptera, Diptera were created by him.

-Due to his contributions, he is considered as the 'father of biological classification'.

##### 3. What is the characteristic feature of biological taxonomy?

-The several taxa in animal taxonomy are the **Phylum, Class, Order, Family, Genus and Species**.

-This arrangement from Phylum to Species is designated as the **hierarchic system of classification**.

##### 4. What are triploblastic animals?

-2. Triploblastic animals - having ectoderm, mesoderm and endoderm as three layers in the body wall.

Eg. : Platyhelminthes

##### 5. Why do we call nematocysts as stinging cells?

-The ectoderm of cnidarians contains stinging cells called **nematocysts (cnidoblasts)**. These cells when triggered can explosively penetrate prey and inject poison.

##### 6. What is a trochophore?

-The larva of Annelida is called the **trochophore**. It is free living.

##### 7. What are amniotes?

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-The tetrapods like **reptiles, birds and mammals** are referred to as amniotes. The amniotes have certain membranes associated with embryos inside the egg.

-These membranes are the **amnion, chorion and allantois**

### **8. Why do we call birds as glorified reptiles?**

-In spite of several advanced features the birds have certain reptilian characters. Hence they are known as “**glorified reptiles**”. Eg. crow

### **9. Name the subclasses under mammalia.**

-The class **Mammalia** is subdivided into three subclasses namely **Monotremata, Marsupialia and Placentalia**.

### **10. Mention any one characteristic feature of the primates.**

-Primates are **omnivorous** in habit. The body is covered with **hairs** except palm, sole and parts of face.

### **11. What are cryptozoites?**

-In human the sporozoites penetrate the liver cells and develop into forms known as **cryptozoites**. A cryptozoite has a compact nucleus and no pigment or vacuoles.

### **12. What is Ookinete?**

-Inside the stomach of the mosquito the zygote assumes an elongated form and is capable of movement. It is known as **ookinete**.

### **13. What is tertian malaria?**

-*P. vivax* causes **benign tertian malaria**, *P. falciparum* is largely limited to the tropics and subtropics and causes the **malignant tertian or subtertian malaria**.

### **14. What are ‘lateral hearts’?**

-In the anterior part of earthworm body the dorsal vessel is connected with the ventral vessel by eight pairs of **commissural vessels** or the **lateral hearts** lying in the segments 6 to 13.

### **15. What is ‘pecten’?**

-Inside the Pigeon eye, a vascular pigmented process projects into the vitreous body. It is known as the **pecten**.

## **Part C**

### **Answer briefly**

#### **1. Provide a brief account on the biodiversity in India.**

-India’s immense biological diversity represents about 7% of world’s flora and 6.5% of world’s fauna. About 62 % animals in India are endemic to the country.

- India is one of the 12 countries identified as mega centres of biological diversity

#### **2. What are the various concepts of species?**

-1. **Typological Species concept** - According to this concept a Species is recognised by its essential characters expressed in morphology.

2. **Nominalistic Species concept** - Species are man made ideas. Nature produces individuals and not Species. Thus a Species is considered as a mental concept.

3. **Biological Species concept** - “Species are groups of interbreeding natural populations that are reproductively isolated from other such groups”.

#### **3. Give an account of the basic principles of nomenclature.**

-1. Providing **stability** in the naming and classification of organisms is emphasized. Any taxon must have only one correct name.

-2. If two or more names are already in use the correct name will be the one that was published earlier. This system is referred to as the **law of priority**.

-3. If two or more workers at one particular time describe the same organism using different names, it results in **synonyms**.

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-4. When names referring to two separate taxa of the same nomenclatural level are spelt the same, the two names are called **homonyms**.

#### **4. Differentiate bracketed and indented keys for identification with a suitable example.**

-The key may be either **bracketed** or **indented**. In a **bracketed key** alternative contrastive characters are used for identification. The number on the right side indicates the next alternative character for consideration. eg. Pointed snout ..... **R. limnochoris**

-In an **indented key** a series of choices are provided for identifying a taxon. The user should choose from among the choices. Eg. blunt snout ..... **R. cyanophlictis**.

#### **5. Write notes on Phylum Annelida.**

-These are worm like animals. The body segments are rings externally. Internally the segments are separated by **septa**. Externally the body is protected by a cuticle.

-Excretion and osmoregulation are achieved by ciliated tubules called **nephridia**.

-For the first time head formation or **cephalization** happens. These are bisexual and hermaphroditic.

-The larva is called the **trochophore**. eg. Earth worm, leech

#### **6. Give a brief account on Protochordates.**

-The protochordates are considered as the fore runners of vertebrates. The classification of the protochordates is based on the nature of the notochord.

##### **-Sub phylum : Hemichordata.**

-These are exclusively marine organisms. They mostly remain as tubicolous forms. vermiform, unsegmented, bilaterally symmetrical and triploblastic. They have no endoskeleton. A projection from pharynx, projecting inside the proboscis **may be** considered as notochord. They have a spacious coelom lined by coelomic epithelium. The alimentary canal is a straight tube running between mouth and anus. They are ciliary feeders. Sexes are separate. Examples : **Balanoglossus, Saccoglossus**.

##### **Sub phylum : Cephalochordata.**

Cephalochordates are small fish like marine chordates. The persistent **notochord extends forward beyond the brain**. Hence these are called cephalochordates. Muscles, nephridia and gonads are segmentally arranged. The pharynx is large with numerous gills. It is a filter feeder. Ex : **Amphioxus**

##### **Sub phylum : Urochordata**

This taxon constitutes a unique group of animals exhibiting diversity in form and habit. In Urochordata the **notochord is confined to the tail region** of the larva. The development occurs through free swimming tadpole like larva. Ex : **Ascidia, Doliolum, Salpa**.

#### **7. Write notes on Primates.**

##### **-Primates :**

This order is of interest because it includes **man**, besides **lemurs, tarsiers, monkeys and apes**.

This group stands first in the animal kingdom in brain development.

-However, most of them are unspecialized and **tree dwelling (arboreal)**.

-Primates are **omnivorous** in habit. The body is covered with **hairs** except palm, sole and parts of face.

-The **neck** is mobile. The forelimbs are shorter than the hindlimb. The limbs have five digits and all the digits end in flat **nail**.

-The **pollex** or **thumb** or **first toe** are smaller than other digits and are **opposable** (except the **hallux** of man).

-The brain is highly developed. The **cerebral hemispheres** are much **convoluted** and cover the cerebellum. The **eyes are directed forward and the vision is binocular and stereoscopic**.

#### **8. What are the types of malaria?**

-There are four species of **Plasmodium** known to cause malaria in man.

- **P. vivax**. It causes **benign tertian malaria** in which the fever recurs every third day (every 48 hours).

- **P. falciparum** is largely limited to the tropics and subtropics and causes the **malignant tertian** or **subtertian malaria**.

- **P. malariae** causes **quartan malaria** with feverish fits every fourth day (every 72 hours).

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-The fourth species is *P. ovale*. It causes **benign tertian malaria** in which the fever recurs every third day (every 48 hours).

### **9. Provide an account on external openings on the body of earthworm .**

#### **-External apertures :**

(i). **Dorsal pores** : These are minute openings situated in the mid dorsal line in the intersegmental grooves commencing from the 10th segment. The coelom communicates to the exterior through these pores and keep the body surface moist and free from harmful micro organisms.

(ii). **Spermathecal openings** : Three pairs of openings are situated ventrolaterally in the intersegmental grooves between segments six and seven, seven and eight and eight and nine. These opening can be easily seen in mature worms.

(iii). **Openings of oviduct** These are a pair of apertures lying close together on the ventral surface of the 14th segment.

(iv). **Openings of Spermiduct** : A pair of apertures are situated on the lowerside of the 18th segment.

(v). **Nephridiopores** : Numerous minute openings scattered on the body wall from 14th segment onwards.

### **10. Write notes on flight muscles in pigeon.**

#### **-Pectoralis major** (Depressor muscles)

These are the largest breast muscles. They are about one fifth of the body weight. By the contraction of this muscle the wings are lowered during flight.

#### **Pectoralis minor or subclavius :-**

These are smaller but longer than pectoralis major. By their contraction the wings are raised in flight.

#### **Coracobrachialis :-**

These small flight muscles pull the wing downwards in flight.

### **Part D**

#### **Answer in detail**

### **1. Define species and provide an account on various animal groups.**

-Each **Family** will contain several Genera (singular : Genus). Each **Genus** again is subdivided into **Species**. In this hierarchy, the Species is considered as the most important taxon.

- A Species represents a natural unit. All other taxa remain arbitrary and are subjected to revision.

- A Species is considered a reality. It is the fundamental unit in taxonomy. Evolution basically operates at the Species level only. Hence the **concept of Species** has received much attention.

#### **-Methods of grouping animals**

I. One of the earliest method of grouping the animals could be dividing the Animal kingdom into two assemblages called **Invertebrata** and **Vertebrata**. This scheme was provided initially by Aristotle. This scheme does not have a place for the Prochordates.

II. Animals can also be grouped as **single celled** and **multicellular**. The single celled organisms are called the **Protozoans**. The multicellular could be called the **Metazoans**. In this arrangement among the metazoans the unique nature of the sponges in not having a tissue grade of body construction is not mentioned.

III. In yet another method the animals are grouped under following three assemblages.

1. **Protozoa** - single celled animals

2. **Parazoa** - Multicellular without tissue grade (sponges).

3. **Eumetazoa** - Multicellular with tissue grade.

**Eumetazoa** is a large group including most of the multicellular animals. Hence it is subdivided further into two groups.

1. Diploblastic animals - having ectoderm and endoderm as two layers in the body wall. Ex : Coelenterata.

2. Triploblastic animals - having ectoderm, mesoderm and endoderm as three layers in the body wall

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The **Triploblastic animals** are further divided into three groups based on the presence or absence of an embryonic body cavity called **coelom**.

1. Acoelomata - no coelom Ex : Platyhelminthes
2. Pseudocoelomata - with a false coelom Ex : Nematoda
3. Coelomata - with a true coelom

IV. In a recent system, the entire living world is subdivided into 5 kingdoms. This system is much more broader including algae, fungi, and plants. It is known as the **Five kingdom concept**.

### **Characters Phylum**

- Single celled animals - Protozoa
- Pore bearers - Porifera
- Common body cavity and digestive cavity - Coelenterata
- Flatworms - Platyhelminthes
- Thread-like worms - Nematoda
- Metamerically segmented animal - Annelida
- Having jointed legs - Arthropoda
- Soft bodied - Mollusca
- Spiny skinned - Echinodermata
- Having notochord - Chordata

## **2. Write an essay on the various methods of taxonomy.**

### **- 1 Methods of taxonomy**

#### **1. Phenetic method or Numerical taxonomy**

This method involves clustering or grouping of individuals of a taxon or several taxa. Based on overall similarity, identifications are being made. The desired size of the clusters or groupings is called the **operational taxonomic unit (OTU)**.

#### **2. Cytotaxonomy**

The characterization and identification of a cell's complete **chromosome** set is referred to as **karyotyping**. Karyotypes within interbreeding populations of a species are usually constant. Between species there may be variation in chromosome number and size. Final stages of chromosomal aberrations such as inversions and translocations can give clues regarding intermediary stages.

#### **3. Chemotaxonomy**

Chemotaxonomy refers to the use of information about small molecules produced by the action of enzymes. Protein fractions in electrophoretic techniques, identification of amino acids in chromatography, prevalence of isoenzymes in tissue materials are all tools employed in chemotaxonomy.

#### **4. Palaeotaxonomy**

This method depends on identification and dating of fossils. Availability of a good complete fossil provides better chance for identification. The fossils are normally studied along with other accompanying fossils, its geographic location and other factors.

## **3. Give a detailed account on the general characters chordates.**

### **- General Characters :**

The three distinctive characteristics of the chordates are the presence of **notochord**, **dorsal tubular nerve cord** and **pharyngeal gill slits**.

#### **1. Notochord :**

During the embryonic development of a chordate there appears a supporting rod called the **notochord**. It lies dorsal to the alimentary canal and ventral to the nerve cord. In some chordates this structure persists throughout life. In others it is partially or completely replaced by a '**backbone**'.

#### **2. Dorsal tubular nerve cord**



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The nerve cord lies just above the notochord and remains entirely outside the coelom. It is a tubular structure having a small hollow canal running from one end to the other. The dorsal hollow nerve cord persists throughout the adult life of almost all chordates.

### **3. Gill slits or Pharyngeal clefts**

These are paired lateral clefts leading from the pharynx to the exterior. They are present throughout life in fishes and a few tailed amphibians. In amphibians, like frogs and toads it is found only in the larval stages. In higher vertebrates (reptiles, birds and mammals) they are embryonic and non-functional.

### **4. Ventral heart**

The heart is chambered. It is located ventral to the alimentary canal.

### **5. Closed blood vascular system**

In chordates, the blood passes through a continuous system of tubes namely arteries, capillaries and veins.

### **6. Hepatic portal system**

In chordates, the food laden blood from the digestive tract passes through the capillary net work in the liver, before reaching the heart. Thus the veins originating from the digestive tract as capillaries and ending in the liver again as capillaries constitute the hepatic portal system.

### **4. Explain the life cycle of Plasmodium in man.**

The life cycle of the malarial parasite involves two hosts, the man and the mosquito. The modes of development in these two hosts are different. In man the mode of reproduction is asexual and in mosquito it is sexual. Man is the **intermediate host** and the mosquito is the **definitive host**.

### **Life cycle in Man - Schizogony**

There are two phases in the life cycle of malarial parasite in man.

-They are (1) **Pre erythrocytic cycle** or **Exoerythrocytic cycle** (in liver cells) and (2). **Erythrocytic cycle** or **Endo-erythrocytic cycle** (inside the red blood corpuscles)

### **1.Pre-erythrocytic cycle:**

-The pre-erythrocytic cycle comprises the asexual reproduction of the parasite in the liver. When an infected female Anopheles mosquito bites a person, thousands of slender, sickle shaped nucleated **sporozoites** are injected in the blood.

-These parasites circulate in the blood for about 30 minutes and enter into the pre-erythrocytic cycle in the **reticuloendothelial cells** of the **liver**.

### **2.Erythrocytic or Endo-erythrocytic cycle.**

-Each cryptomerozoite makes its way into a red blood corpuscle and feeds on its contents. After some time, the parasite gets an amoeboid shape. This growing stage is known as the **trophozoite**.

-The nucleus is pushed to one side. This stage is called the **signet ring** stage. With further growth the vacuole disappears and the amoebula occupies the entire interior of the corpuscle. This stage is known as the **schizont** stage. In the schizont, the nucleus breaks up into bits (6-24) and each becomes surrounded by a small amount of cytoplasm. These cells are known as **merozoites**.

-The life cycle in the blood of man is called the **cycle of Golgi** or **schizogony** or **endoerythrocytic cycle**. The gametocytes are of two types - **macro-gametocytes** and **micro-gametocytes**.

-The macrogametocyte has a small nucleus and a dense food laden cytoplasm. The micro-gametocyte has a relatively large nucleus and clear cytoplasm.

-Their further development depends on their entry into the stomach of a female *anopheles*.

### **5. Describe the external features of *Columba livia*.**

#### **-External features.**

-The Body is spindle shaped. Their size varies from 20-25 cm. They are covered by coloured feathers leaving beak and a small portion of the hindlimbs. The body is divisible into **head, neck, trunk** and a small, conical **tail**.

-The head is round and drawn out anteriorly into a strong, hard, pointed **beak**. The mouth is a terminal wide gape, guarded by elongated upper and lower beaks. The beaks are covered with a horny sheath or **rhampotheca**.

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- A swollen area of soft skin, the **cere**, surrounds the **nostril**. It is present on each side of the upper beak. -
- The **eyes** are large and guarded by upper and lower **eyelids** and a transparent **nictitating membrane**.
- A pair of **ear openings** are situated at a short distance behind the eyes. Each opening leads into a short **external auditory meatus**, ending in the **tympanic membrane** forming the ear drum
- The neck is long and mobile. It helps in the movement of the head in various directions. The trunk is compact, heavy and bears a pair of **wings** and a pair of **legs**.
- The **cloacal aperture** is at its hind end on the lower surface. Projecting behind the cloacal aperture is the tail. Above the tail is a knob on which opens an **oil gland** or **preen gland** or **uropygeal gland**.
- It secretes a fluid used for preening the feathers.



#### **6. Give a detailed account on the reproductive system and the process of reproduction in earthworms.**

##### **Reproductive System :**

-Both male and female reproductive organs are present in the same worm. Hence the earthworms are known as **hermaphrodites**. Since the sperms develop earlier than production of ova, self-fertilization is avoided. It is known as **protandry**.

##### **Male reproductive organs :**

-The male sex organs are formed of two pairs of **testes** and a pair of **vasa deferentia**. Testes are found in segments 10 and 11. They are tufts of finger shaped processes attached to the anterior septa of segments 10 and 11.

-There are two pairs of seminal vesicles formed as outgrowths of the testicular segments. Further two pairs of **seminal funnels** called **ciliary rosettes** are situated in the same segment as the testes.

-The ciliated funnels of the same side are connected to a long tube called **vas deferens**.

-18<sup>th</sup> segment where they open to the exterior through the male genital aperture.

-Male genital apertures contain **penial setae** for copulation. A pair of **prostate glands**, each in the form of a much coiled tube are situated in segments 18 and 19. The prostate glands open to the exterior along with the vasdeferens.

-The secretion of the prostate glands help to arrange the sperms into bundles called **spermatophores**

##### **Female reproductive organs.**

-A pair of **ovaries** are found lying in segment 13. They are attached to the anterior septum of the 13<sup>th</sup> segment. Each ovary is a flat structure with a number of finger like processes. The ova are arranged in a linear order in the ovaries.

-There are a pair of **oviducts**. They open internally into the 13<sup>th</sup> segment and externally on the ventral surface of the 14<sup>th</sup> segment. Three pairs of **spermathecae** are present in segments 7, 8 and 9. These external openings are situated in the intersegmental grooves of segments 6 and 7, 7 and 8, and 8 and 9.

-The spermatozoa received from another individual during copulation are stored in **spermathecae**

##### **Copulation:**

-During copulation the head ends of the two worms are directed in the opposite directions and the clitellum of one worm is opposite to the spermathecal segments of the other.

-The spermatozoa of one worm pass into the spermathecae of the other worms. The worms separate after the mutual exchange of spermatozoa.

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- Later the glandular cells of the clitellum secrete a thick fluid which hardens into a **girdle** surrounding the clitellum.
- The girdle containing the germ cells (ova and sperms) and the nutrient albuminous fluid is slipped off at the anterior end and it becomes a closed sac called the **cocoon**.
- Fertilization and the development of the eggs into worms takes place within the cocoon. Young worms come out of the cocoon after complete development.



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## 2. CELL BIOLOGY

### Part I

#### Choose the correct answer

1. Living cells which are wet cannot be viewed in a / an **-c) Electron microscope .**
2. The increase in size of optical image over the size of the object is known as **-(c) power of magnification**
3. The name 'cell' was coined by **(c) Robert Hook**
4. In a microscope the light is focussed on the object through **(a) condenser lens**
5. A three dimensional image of the object can be produced using **d) scanning electron microscope**
6. In microscopy a nucleus is normally stained using **-(d) Hematoxylin**
7. In cytological technique Bouin's solution is used for **-(a) fixation**
8. A unit membrane hypothesis for plasma membrane structure was provided by **-(c) Robertson**
9. In the plasma membrane the lipid bilayer is covered by **-(a) proteins**
10. The role of mitochondria in oxidative phosphorylation was explained by **-(a) Leninger**
11. Which of the following is called as the cell respiratory organelle **-(d) mitochondria**
12. The ribosomes are meant for **-(c) protein synthesis**
13. Which of the following organelle forms the intra cellular transporting system **-(c) Endoplasmic reticulum**
14. Which of the following cell may not contain golgi apparatus **-(c) RBC**
15. The lysosome originates from **-(d) golgi apparatus**
16. The movement of the flagellum is regulated by **-(c) basal body**
17. The number of nucleus (nuclei) in matured mammalian erythrocytes is **-(d) nil**

### Part – II

#### Give very short answer

#### 1. Write a note on phase contrast microscope.

-Phase contrast microscopy avoids the need to kill cells or to add dye to a specimen before it is observed microscopically.

#### 2. What is 'limit of resolution' in the functioning of a microscope ?

-While viewing objects, human eyes have limited distinguishing or resolving power. The ability to reveal minute details is expressed in terms of **limit of resolution**.

#### 3. Name the various parts of a compound microscope.

- Objective lens, ocular lens or eyepiece, condenser lens, slide stage, mirror, handle, base.

#### 4. What are vital stains ?

-Vital dyes or stains are taken up by living cells without killing them. Eg. **methylene blue; Neutral Red**

#### 5. Name two biochemical processes happening within the mitochondria.

-Mitochondria perform several important functions such as **oxidation, dehydrogenation, oxidative phosphorylation and respiratory chain** of the cell.

#### 6. What are RER and SER ?

-The presence of ribosomes gives a granular appearance. In this condition ER is described as **rough endoplasmic reticulum (RER)**. -Ribosomes are absent on **smooth endoplasmic reticulum (SER)**.

#### 7. What is 'autolysis' ?

-When a cell dies its own lysosomes release the enzymes that digest the remains of the cell in a process known as **autolysis**.

#### 8. When do we call centriole as a basal body.

-When a centriole supports a flagellum or cilium, it is called the **basal body**.

#### 9. What are the types of chromosomes based on the nature of their arm ?

-Telocentric, Acrocentric, Submetacentric and Metacentric.

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### 10. What is a 'fluid mosaic model' of a plasma membrane ?

- Singer and Nicholson (1972) have proposed a **fluid mosaic model** for the plasma membrane.
- The fluid mosaic membrane is a dynamic structure. In this structure much of the protein molecules float about. Some of them are anchored to the organelles within the cell.

### Part - III

#### 1. Write notes on cell theory.

- 'All living things are made up of cells'. 'The cell is the basic unit of structure and function'. These generalised statements are known as **Cell theory**.
- This theory was forwarded by **Mathias Schleiden** and **Theodor Schwann** in 1838 - 39.

#### 2. Explain the various units of measurement in cell biology .

- The Systeme International (SI) units of length are
- 1 metre (m) = 1000 millimetres (mm), 1 mm ( $10^{-3}$ m) = 1000 micrometres ( $\mu$ m),
- 1  $\mu$ m ( $10^{-6}$ m) = 1000 nanometres (nm), 1 nm ( $10^{-9}$ m) = 1000 picometres (pm)

#### 3. Differentiate TEM and SEM.

##### TEM

- The final image is viewed on a screen or is recorded on photographic film to produce **electron micrograph**. This type of electron microscope is called transmission electron microscope (TEM)

##### SEM

- An image is created by the electrons reflected from the surface of the specimen. Scanning electron micrographs show depth of focus and a three dimensional image of the object.

#### 4. Provide the structure of the golgi apparatus.

- The simplest unit of the Golgi apparatus is the **cisterna**. A cisterna is about 1  $\mu$ m in diameter.
- It has a membrane bound space. This space accumulates secretions.
- Numerous such cisternae are associated with each other and appear in a lamellar arrangement.
- In the lamellar arrangement the space between each cisterna is 20-30 nm. A group of these cisternae is called the **dictyosome**.

#### 5. Write notes on the organisation of a centriole.

- The microtubules are made up of a structural protein, **tubulin**, along with lipid molecules.
- It was initially considered that new centrioles arise by the division of existing centrioles.
- It appears that new centrioles are produced **de novo** or are synthesized using an existing centriole as a template. In most of the animal cells the centrioles are the focal point for the **centrosome**.
- In mitosis. It provides the two poles of the **mitotic spindle**. The centrioles form the basal body and the cilia.

### Part – IV

#### 1. Give an account of types of microscopes.

##### 1. Compound light microscope

This microscope uses visible light for illuminating the object. It contains glass lenses that magnify the image of the object and focus the light on the retina of the observer's eye.

##### 2. Dark field microscope

This type of microscope is useful for viewing suspensions of bacteria. It has a special **condenser** that allows only rays of light scattered by structures within specimen.

##### 3. Phase contrast microscope

Phase contrast microscopy avoids the need to kill cells or to add dye to a specimen before it is observed microscopically.

##### 4. Oil - immersion microscopy

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In oil-immersion microscopy the light gathering properties of the objective lens are enhanced by placing oil in the space between the slide and objective lens. Normally the technique is used to view permanently mounted specimens.

### **5. Electron microscopy.**

The electron microscopy uses the much shorter wavelengths of electrons to achieve resolutions as low as 3Å. **Electromagnetic coils** (ie., magnetic lenses) are used to control and focus a beam of electrons accelerated from a heated metal wire by high voltages, in the range of 20,000 to 100,000 volts.

### **2. Describe how a specimen is prepared for microscopic study.**

#### **Preserved and stained tissues :-**

-For detailed microscopic study, tissues containing cells are passed through various stages. The stages of cell preparation on a glass slide involves killing, fixation, dehydration, embedding, sectioning, staining and mounting.

1). **Killing and fixation** :- This process causes sudden death of cells or tissues and preserves freshly killed tissues in as lifelike a condition as possible. A good fixative prevents bacterial decay and autolysis. It will also make different cell components more visible and prepare the cell for staining. The commonly used fixatives are Acetic acid, Formaldehyde, Bouin's solution and Carnoy's fluid.

2). **Dehydration** :- In this process water vapour is removed from cells or tissues using chemical agents. It is done by using ethanol and benzene.

3). **Embedding** :- The tissues are infiltrated with molten paraffin wax. It hardens up on cooling and provides enough support to allow thin sections. Very thin sections need to be taken for electron microscopy. Hence plastics are used for embedding.

4). **Sectioning** :- The embedding material is cut into thin sections of needed thickness. It is done by using an instrument called **microtome**.

5). **Staining** :- The sections are immersed in dyes that stain some structures better than others. For example, cytoplasm stains pink with eosin. Nucleus stains blue with haematoxylin or red with safranin.

6). **Dehydration** :- Stained sections are immersed in ethanol to remove water. The tissue becomes more transparent. Dehydration is done gradually by using a series of increasing concentrations of ethanol in water. Finally the section is placed in 'absolute' alcohol.

7). **Mounting** :- Cleaned sections are mounted on a slide using a suitable medium like Canada balsam. A cover slip is added and the medium is allowed to dry.

### **3. Write an essay on structure and functioning of mitochondria.**

#### **STRUCTURE**

-The mitochondria may be filamentous or granular in shape. They vary in size from 0.5 µm to 2.0 µm.

-Due to their minute nature they can not be seen under light microscope.

-Each mitochondrion is bound by two highly specialized membranes.

-The outer membrane is smooth. It is separated from the inner membrane by a 6-8 nm wide space.

-The **inner membrane** is highly convoluted, forming a series of infoldings known as **cristae**.

-Thus mitochondria are double membrane envelopes. The inner membrane divides the mitochondrial space into two distinct chambers.

The outer compartment is the **peri-mitochondrial space**. It is found between outer and inner membranes.

-The inner compartment is the **matrix space**. It is filled with a dense gel like substance called **mitochondrial matrix**.

-The matrix contains **lipids, proteins** and **circular DNA molecules**.

#### **FUNCTION**

-The outer and inner membranes, intermembrane space and mitochondrial matrix contain several enzymes. Hence the mitochondria perform several important functions such as **oxidation, dehydrogenation, oxidative phosphorylation** and **respiratory chain** of the cell.

-Since mitochondria play a key role in the oxidation of carbohydrates and fats, they are considered as the actual **respiratory organs** of the cells.

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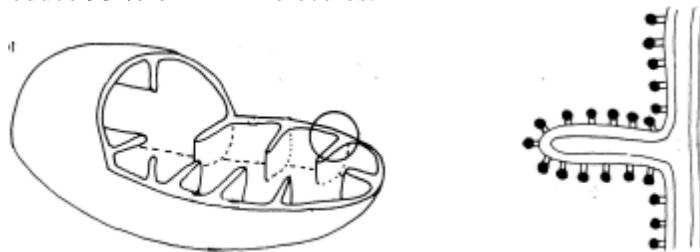
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- During such biological oxidations large amount of energy is released. The energy is utilized by the mitochondria for synthesis of the energy rich compound known as **adenosine tri phosphate** or **ATP**.
- Due to this function, the mitochondria are also known as “**power houses**” of the cell. In animal cells mitochondria produce 95 % of ATP molecules.



#### 4. Provide a detailed account on the organisation of cell nucleus.

##### NUCLEUS

- Usually the cells contain single nucleus (**mononucleate**). However certain cells may have more than one nuclei. Accordingly they may be called **binucleate** or **polynucleate** cells.
- The polynucleate cells of the animals are called **syncytial cells** (Osteoblast cells) The shape of the nucleus may be **spherical, elliptical** or **discoidal**.
- The nucleus is surrounded by a **nuclear envelope**. This envelope is comprised of two membranes of 5-10 nm thickness. The **inner nuclear membrane** supports a fibrous sheath called the **nuclear lamina**.
- The inner nuclear membrane is surrounded by the outer nuclear membrane. The space between the inner and outer membranes is known as **perinuclear space**.
- It is a 10 to 50 nm wide fluid filled compartment. The **nuclear lamina** is a protein meshwork.
- The nuclear envelope is perforated by **nuclear pores**
- The nucleus is filled with a transparent semisolid matrix known as **nucleoplasm** or **nuclear sap**.
- The nucleoplasm contains several thread like coiled structures. These are the **chromatin fibres**.
- The chromatin is made up of **Deoxy - ribose nucleic acid** (DNA) and proteins.
- The nucleus contains one or more spherical colloidal structures called **nucleoli**.
- The size of nucleolus is related to the synthetic activity of the cell.
- Chemically, nucleolus contains DNA of nucleolar origin, four types rRNA, 70 types of ribosomal proteins, RNA binding proteins and RNA splicing nucleoproteins.
- Ribosomal** subunits are synthesized in the nucleolus. **Initiation, production** and **maturation** stages of ribosomal formation happen in three distinct regions of the nucleolus.



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### 3.HUMAN ANATOMY

#### Choose the correct answer

1. The cornified region of the skin is formed of - d) stratum corneum
2. The goose flesh is formed due to the contraction of - b) erector pili
3. The number of facial bones are- c) 14
4. The cervical vertebra supporting the head is - b) atlas
5. The broadest muscles are named as - d) lattismus
6. The major breathing movement is due to- c) diaphragm
7. The largest salivary glands are - a) parotid
8. The length of the duodenum in human alimentary canal is- d) 25 cm
9. Breathing process can be interfered with due to - b) enlargement of the tonsil
10. The reduction in blood pressure may be caused due to - b) resistance vessel
11. Vaso-dilation and vaso-constriction are caused by - c) tunica media
12. The wall of the blood vessels are supplied with blood by - c) vasa vasorum
13. Spleen is located on the left side of- a) the abdominal cavity
14. The synapses are formed between - b) nerve tissues
15. The cerebral hemispheres are connected by a sheet of nerve fibres called- c) corpus callosum
16. The interocular pressure is maintained by - a) aqueous humor
17. The hypophysis is connected with the brain through- c) hypothalamus
18. The average weight of human thyroid gland is- b) 20 gms
19. The inner layer of membrane lining the uterus is- c) endo metrium

#### Part - II

#### 1. What is keratinization ?

- In skin new cells are formed, the older cells are pushed to the surface.



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- The surface cells will protect the inner new cells.
- Gradually the shape and chemical nature of the surface cells will get altered.
- Slowly they get filled with keratin. This process is called keratinization

## 2. What are floating ribs ?

11th 12th pairs of ribs not attached to the sternum. They are called floating ribs.

## 3. What is a synovial joint ?

- These joints contain a synovial fluid.
- This fluid is a complex mixture of polysaccharides, proteins, fats and cells.
- It forms a thin lubricating film covering the surfaces of a joint.
- Eg..Elbow and knee joints

## 4. Differentiate skeletal and visceral muscles.

1). Skeletal muscles or striped muscles : These muscles are attached to the bones. The muscle cells are long and cylindrical. These voluntary muscles cause body movements.

2). Visceral muscles or Nonstriated muscles: These are found in the walls of the inner organs such as blood vessels, stomach and intestine. The muscle cells are spindle shaped. These are involuntary in nature.

## 5. Name the kissing muscles

Orbicularis oris and Buccinator muscles provide lip movement for kissing posture they are known as "kissing muscles".

## 6. Provide the human dental formula

i 2/2 : c 1/1 : pm 2/2 m 3/3 X 2      or      2123/2123

## 7. What is carina ?

- The basal part of the trachea divides to form 2 smaller tubes called the primary bronchi (sing : bronchus).
- The cartilage ring found at the basal region is called the carina.
- Foreign objects reaching carina stimulate a powerful cough reflex.

## 8. Provide the root of systemic circulation

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Left ventricle .....O<sub>2</sub> distribution to body.....CO<sub>2</sub> blood from body cell..... right atrium

### 9. What is the role of B-lymphocytes ?

The B-lymphocytes or B cells synthesize antibodies for recognizing and neutralising alien macromolecules.

### 10. What is a neuromuscular junction ?

- In the terminal regions of the effector nerves the axon of the nerve cells are in contact with the muscle tissue.

- These joints are named as neuro - muscular junctions

### 11. What is choroid plexuses ?

-The ependymal cells, their supportive tissue and the associated blood vessels together are called choroid plexuses.

-The plexuses are formed by invagination of the vascular piamater into the ventricles

### 12. What is melbomian gland ?

-The inner margin of the eyelids contain Melbomian glands.

-These glands produce sebum for lubricating the eyelids.

### 13. What is Rathke's pouch ?

- During embryonic development an outpocketing of the roof of the oral cavity arises. It is called as the Rathke's pouch.

-This pouch grows towards the posterior pituitary.

### 14. What are podocytes ?

-The inner visceral layer of bowmens capsule surrounds the glomerulus.

- It consists of specialized cells called podocytes.

### 15. What is the role of prostate glands ?

-The muscular part of the prostate may help in dilating the urethra to hold the seminal fluid (3-5ml) during the period of sexual excitement prior to ejaculation.

## Part – III

### 1. Give an account of the nail and its structure

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### Nails :-

- Each nail is made up of two parts. They are the nail root and the nail body.
- The nail body is the visible part. The nail root is covered by the skin. The proximal and lateral edges of the nail are covered by nail fold.
- The stratum corneum of the nail fold grows onto the nail body as the eponychium.
- The free edge of the nail body is the hyponychium.
- The nail is found placed on the nail matrix and nail bed.
- A small white region seen at the base of the nail is the lunula.
- It contains the nail matrix. The nails grow at an average rate of 0.5-1.2 mm per day.

### 2. Describe the structure of typical human vertebra

#### Vertebra - Structure :

- The main load - bearing portion of a vertebra is a solid disc of bone called the centrum.
- The centra of adjacent vertebrae are separated by intervertebral discs of cartilage. - Projecting from the centrum dorsally is a vertebral arch. It encloses the neural canal. This canal contains the spinal cord.
- Several bony projections are seen on the vertebral arch. On each side of the centrum there are two transverse processes.
- On the dorsal side there is a neural spine. These bony projections are used for attachment of muscles.
- Further, there are two superior and two inferior processes meant for articulation with the neighbouring vertebra.

### 3. Give an account of the muscles of the lower limb

- Thigh movements are caused by anterior, postero-lateral and deep muscles.
- The anterior muscles are the iliacus and psoas major which help to flex the thigh.
- The gluteus maximus form the mass of the buttocks region.
- Leg movement is caused by the anterior thigh muscles, quadriceps femoris and sartorius. -- The sartorius is the longest muscle of the body. It runs from the hip to the knee.

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-Muscle movement of ankle foot and toe are caused by several groups of extrinsic and intrinsic muscles.

#### 4. Give description of the human liver

##### Liver :

- It is the largest visceral organ. It weighs about 1.36 Kg.
- The liver consists of two major left and right lobes, and two minor lobes caudate and quadrate.
- The bile secreted by the liver gets collected in the gall bladder.
- There are two hepatic ducts and they unite to form a single duct.
- The common hepatic duct is joined by the cystic duct from the gall bladder to form the common bile duct. It empties into the duodenum

#### 5. Describe the paired and unpaired cartilages of larynx

- The larynx is seen just behind the pharynx and the buccal cavity.
- This region is surrounded by cartilages(3 unpaired and 6 paired).
- These are interconnected by muscles and ligaments.
- The unpaired cartilages are the thyroid, cricoid and epiglottis.
- The thyroid cartilage is the largest. It is also known as the Adam's apple

#### 6. Write notes on portal circulation

##### Portal circulation :-

- In the systemic circulation the venous blood passing through spleen, pancreas, stomach and intestine is not carried back directly to the heart.
- It passes through the hepatic portal vein to the liver.
- This vein begins as capillaries from the visceral organs and ends in the liver again as capillaries.
- These capillaries converge to form the hepatic vein which joins the inferior vena cava, conveying blood to right atrium. This route is the portal circulation

#### 7. Give on account of the thymus

##### Thymus

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- It is a roughly triangular, bilobed gland. It is located in the mediastinum (ie., between the lungs).
- It lies between the sternum and the pericardium. Its size varies with age. It is largest in the early part of life (upto 15 years).
- At birth it weighs 10 - 15 g. After puberty it greatly decreases in size.
- Each thymus lobe is surrounded by a thin capsule made of the connective tissue.
- It has 2 layers. The inner layer is the medulla, the outer layer is cortex. The lymphocytes are found only in cortex layer

#### 8. What is the structure of a peripheral nerve ?

- A nerve is made up of several nerve fibres. A nerve fibre contains axons with their coverings called schwann cells.
- The fibres are grouped into fasciculi. The number and pattern of fasciculi vary in different nerves.
- Thus a nerve trunk possesses many such fasciculi. Such a trunk is surrounded by an epineurium.
- The individual fasciculi are enclosed by a multilayered perineurium.
- The perineurium surrounds the endoneurium or intra fascicular connective tissue

#### 9. Explain the organization of the lacrimal apparatus in human eye

- The lacrymal glands or tear glands are situated in the superolateral corner of the eye orbit. They produce tear at the rate of about 1 ml / day. It.
- Compartments of the eye aqueous humour vitreous humour helps to moisten the eye surface and wash away foreign substances.
- At the corners of the eye there are small openings called the puncta. Each punctum inturn opens into a lacrymal canaliculus.
- The lacrymal canaliculi open into a lacrimal sac. This sac enters into a nasolacrimal duct which opens into the inferior nasal concha.
- These ducts help to drain the excess tear. The entire organization related to 'tear' is called the 18achrymal apparatus



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### **10. Describe the endocrine nature of the pancreas**

- The pancreas is both an exocrine and an endocrine gland.
- The endocrine part consists of pancreatic islets (islets of Langerhans).
- They are approximately 500,000 to 1,000,000 in number.
- The islets are distributed in the pancreas.
- The islets are composed of alpha ( $\alpha$ ) cells (20%) and beta ( $\beta$ ) cells (75%).
- While the  $\alpha$  cells secrete glucagon the  $\beta$  cells secrete insulin.
- A third type of cells called the delta ( $\delta$ ) cells (5%) have been identified. These cells secrete somatostatin.

### **11. Provide the structure of human kidney**

- Each kidney is enclosed by a fibrous connective tissue layer, called the renal capsule.
- outer cortex and an inner medulla. The medulla consists of several cone-shaped renal pyramids.
- Extensions of the pyramids called the medullary rays, project from the pyramids into the cortex.
- Extension of the cortex called renal columns, project between the pyramids.
- The tips of the pyramids are called the renal papillae. They are pointed toward the renal sinus.
- The renal papillae are surrounded by funnel shaped structures called the minor calyces.
- The minor calyces of several pyramids join together to form larger funnels called major calyces.
- There are 8-20 minor calyces and 2 or 3 major calyces per kidney. The major calyces converge to form an enlarged channel called the renal pelvis.
- The renal pelvis then narrows to form the ureter. The ureter leaves the kidney and gets connected to the urinary bladder

### **12. Give an account of corpus luteum**

#### **Corpus luteum**

- It is formed after ovulation. The walls of the empty follicle collapse and fold extensively.

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-The granulosa cells of the theca externa get enlarged. They are now termed as luteal cells. They secrete hormones.

- In pregnancy the corpus luteum persists. Otherwise, it degenerates after 10-12 days.

-The connective tissue cells get enlarged. It becomes white in colour and is now called as the corpus albicans.

#### Part – IV

##### 1. Write an essay on the structure and organization of the axial skeleton in human beings.

**Axial skeleton** - It forms the upright axis of the body. It protects the brain, the spinal cord and the vital organs found within the thorax.

**a) Skull** - The human cranial capacity is about 1500 cm<sup>3</sup>. It consists of 22 bones. It protects the brain. It supports the organs of vision, hearing, smell and taste. The lower jaw or mandible remains specially attached to the skull. The skull or cranium is covered by eight bones. They are one pair each of parietal and temporal, individual bones as frontal, sphenoid, occipital and ethmoid. These bones are joined by sutures to form a compact box like structure. The sutures are immovable

**b). Vertebrae** - The vertebrae make up the slightly S-shaped vertebral column or backbone. The vertebral column consists of 26 bones. They are divided into 5 regions. They are the cervical (7), thoracic (12), lumbar (5), sacral (1) and coccygeal (1) vertebrae.

**c). Rib cage** - There are 12 pairs of ribs. Each articulates with a thoracic vertebra. In the front, the first ten pairs are attached to the sternum (breast bone) by costal cartilages. The first seven are attached directly to the sternum. They are called the true ribs. Cartilages of 8th, 9th and 10th ribs are fused and attached to 7th. They are called the false ribs. 11th 12th pairs are not attached to the sternum. They are called floating ribs

##### 2. Give an account of the organs of digestion in the buccal cavity

**Tongue** - It is a large muscular organ. It is attached to the floor of the oral cavity. The anterior part of the tongue is free. A thin fold of tissue called the frenulum attaches the free end to the floor of the mouth. The tongue is divided into two parts by a groove called the terminal sulcus. About two thirds of the anterior surface is covered by papillae. Some of them contain taste buds.

**Teeth** - There are 32 teeth in the mouth of a human adult. These are called as permanent teeth. There are 4 different types of permanent teeth seen. This nature is known as heterodontism. The types of teeth are incisors(8), canines(4), premolars(8) and molars(12). Since the teeth in the right and left side of the mouth are mirror images of each other, the dental arrangement is represented as follows. i 2/2 : c 1/1 : pm 2/2 m 3/3 X 2 or 2123/2123

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**Salivary glands :** These are scattered throughout the oral cavity. Three pairs of glands are larger. They are the parotid, submandibular and sublingual glands. The Parotid glands are the largest. They are located just anterior to the ear on each side of the head. The submandibular glands are found on the inferior borders of the mandible. The sublingual glands are the smallest. They lie immediately below the mucous membrane in the floor of the mouth. There are other numerous small, coiled, tubular glands in the mouth. They are the lingual (tongue), palatine (palate), buccal and labial (lips) glands.

### **3. Write an essay on structure and types of blood vessels**

**Structure of blood vessels :** The blood vessels show a vast range of structural modifications. However a few basic patterns can be studied. A blood vessel consists of a wall and a lumen or cavity. The wall of the blood vessels is made up of 3 distinct layers or tunica. They are the tunica intima, tunica media and tunica externa or tunica adventitia. The tunica intima is formed of an endothelium, a delicate connective tissue and elastic fibres. The tunica media contains smooth muscle cells. It causes vasoconstriction and vasodilation. The tunica externa is composed of connective tissue. The composition and thickness of layers varies with the diameter of the blood vessels and the type.

#### **Types of blood vessels :**

**1. Large elastic arteries :-** The walls of these arteries contain elastic fibres. The smooth wall measures about 1 micron in thickness. It gets stretched under the effect of pulse and recoils elastically.

**2. Muscular arteries :-** There are larger and smaller muscular arteries. The larger muscular arteries are inelastic and they have thick walls. The wall has 30-40 microns in diameter in the layers of smooth muscles. Since they regulate blood supply, they are called distributing arteries. The small muscular arteries are capable of vasodilation and vasoconstriction.

**3. Arterioles :-** They conduct blood from the arteries to the capillary bed. These are small vessels capable of vasodilation and vasoconstriction.

**4. Capillaries :-** These are fine vessels found between arterioles and venules. They measure 5-8 micron in diameter.

**5. Venules :-** These are tubes of flat, oval or polygonal endothelial cells. Each venule is formed by the convergence of two or more capillaries. Its diameter ranges up to 30 micron.

**6. Veins :-** Veins seen in anatomy are medium veins. They run in between venules and large veins. Large veins transport blood to the heart.

### **4. Provide a detailed description of the anatomy of human brain**

#### **1. Brain**

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The brain is safely kept inside the cranial vault. Inside the skull the brain is surrounded by three protective coverings. They may be grouped under two divisions.

**A. Pachymeninx** - It includes the duramater.

**B. Leptomeninges** - It includes the arachnoid mater and pia mater.

The duramater is the outermost membrane. It is thick and inelastic in nature. The arachnoid mater is the middle covering over the brain. In between arachnoid and pia mater there is a space called the subarachnoid space. It contains cerebro-spinal fluid and blood vessels. The pia mater is a delicate membrane closely applied to the brain. This membrane contains blood capillaries supplying blood to the brain cells.

The human brain weighs about 1.3 Kg. It contains more than a billion neurons. Based on embryological development the brain can be divided as follows.

**1. Prosencephalon (Fore brain)** - It consists of the cerebrum and the diencephalon. The cerebrum is the largest part of the brain. It is divided into right and left hemispheres by a longitudinal fissure. However, at the base the two hemispheres are connected by a sheet of nerve fibres called the corpus callosum.

The outer surface of the cerebrum is called the cortex or grey mater. It is 2 to 4 mm thick. The inner content of the cerebrum is the white mater. The surface of the cerebrum has several folds called the gyri. They greatly increase the surface area of the cortex. The shallow grooves in between the gyri are called the sulci. A central sulcus runs in the lateral surface of the cerebrum from superior to inferior region. Each cerebral hemisphere is divided into four lobes. They are the frontal at the front, the parietal towards the top of the head, the temporal on the side and the occipital at the rear. The diencephalon contains the thalamus and hypothalamus. This region is found between the cerebrum and the brain stem. The thalamus has a cluster of nuclei which act as the relays for particular sensory pathways. Just beneath the thalamus, the hypothalamus is present. It contains reflex centres linked to the autonomic system. A funnel shaped stalk called the infundibulum extends from its floor. It is connected to the neurohypophysis of the pituitary gland.

**2. Mesencephalon (mid brain)** - It is the smallest region of the brainstem. On its dorsal surface there are four rounded bodies called the corpora quadrigemina.

**3. Rhombencephalon (hind brain)** - The three main regions of the rhombencephalon are the medulla oblongata, the pons varoli and the cerebellum. The cerebellum consists of two hemispheres. Its surface has many ridges called folia. The cerebellum consists of three parts. They are the small anterior flocculonodular lobe, a narrow central vermis and two large lateral hemispheres. The pons is just superior to the medulla oblongata. It contains ascending and descending nerve tracts. The medulla oblongata is about 3 cm long. It is continuous with the spinal cord. It remains as a bridge between the brain and the spinal cord.

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## **5. Give an account of the structural organization of the hypophysis**

### **Pituitary gland (or) Hypophysis**

It is an organ, that secretes eight major hormones. These hormones regulate numerous body functions and controls the secretory activities of several other endocrine glands. The hypothalamus of the brain is connected to the pituitary. The posterior pituitary is an extension of the hypothalamus. Structure of the pituitary gland. This gland is approximately 1 cm in diameter. It weighs 0.5-1g. It is placed in a region called the sella turcica of the sphenoid bone in the floor of the skull. It is placed inferior to the hypothalamus. It is connected to it by a stalk of tissue called the infundibulum. Based on origin and function the pituitary is divided into two parts. They are the posterior pituitary or neurohypophysis and anterior pituitary or adenohypophysis.

**Posterior pituitary or Neurohypophysis.** The posterior pituitary is continuous with the brain. Hence it is called the neurohypophysis. During embryonic development, it is formed as an outgrowth of the inferior part of the brain in the area of the hypothalamus. The outgrowth of the brain, forms the infundibulum. The distal end of the infundibulum enlarges to form the posterior pituitary. Since this part of the pituitary is an extension of the nervous system, its secretions are known as neurohormones.

**Anterior Pituitary or Adenohypophysis** During embryonic development an outpocketing of the roof of the oral cavity arises. It is called as the Rathke's pouch. This pouch grows towards the posterior pituitary. Later, the pouch loses its connection with the oral cavity and becomes the anterior pituitary. The anterior pituitary is subdivided into three areas. They are, the pars tuberalis, pars distalis and pars intermedia.

## **6. Write an essay on the human male primary sex organs and associated structures.**

### **Male reproductive organs**

The male reproductive system consists of the testes (singular : testis), epididymides (sing: epididymis), ductus deferentia or vasa deferentia (sing : ductus deferens, vas deferens), urethra, seminal vesicles, prostate gland, bulbourethral glands, scrotum and penis.

**Testes :** The testes are the primary reproductive organs or gonads in the male. These are suspended in the scrotum by scrotal tissues. The sperm cells are temperature sensitive. They do not develop normally at usual body temperatures. Hence the testes and epididymides in which the sperm cells develop, are located outside body cavity in the scrotum, where the temperature is low. The left testis usually is 1 cm lower than the right. An average testis is 4-5 cm in length, 2-5cm in breadth. Its weight varies from 10.5-14g. The outer part of each testis is a thick, white capsule called tunica albuginea. Internally the testis contains several incomplete septa. The septa divide each testis into about 300-400 cone shaped lobules. The lobules contain seminiferous tubules and interstitial cells or Leydig cells. Sperm cells develop within the seminiferous tubules.



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**Epididymis** : It is formed of extremely convoluted ductules coming out of the testis. It occurs on the posterior side of the testis. The maturation of sperm cells occurs within the ductules of the epididymis.

**Vas deferens or ductus deferens** : It emerges from the tail end of the epididymis and ascends along the posterior side of the testis. It becomes associated with the blood vessels and nerves that supply the testis. Collectively these structures constitute the spermatic cord. Thus the spermatic cord consists of (1) Vas deferens (2) testicular artery and vein plexus (3) lymph vessels (4) nerves (5) fibrous processes and muscles. This cord enters into the pelvic region. The end of the vas deferens enlarges to form the ampulla. At this region the vas deferens is surrounded by smooth muscles capable of peristaltic contraction. They help to propel the sperm cells through the ductus deferens.

**Ejaculatory duct** : Nearer to the ampulla of each vas deferens there is a sac like seminal vesicle. It joins the ductus deferens to form the ejaculatory duct. These ducts are about 2.5 cm long. They project into the prostate gland and end by opening into the urethra.

**Urethra** : The male urethra extends from the urinary bladder to the distal end of the penis. It is about 20 cm long. It is a passageway for both urine and reproductive fluids.

**Penis** - It is the male copulatory organ. It consists of two parts namely the radix or root and the corpus or body. The radix attaches the penis to the lower abdomen. The corpus is normally pendulous. It is covered by a loose skin.

**Seminal vesicles** - These are two sac-like structures located between the bladder and rectum. Each vesicle is about 5 cm long. Their secretions contribute about 70% of the seminal fluid.

**Prostate** - It is a firm structure. It is partly glandular and partly fibromuscular. It is found around the beginning of the male urethra. It is about 3 cm in diameter. It weighs about 8g. The muscular part of the prostate may help in dilating the urethra to hold the seminal fluid (3-5ml) during the period of sexual excitement prior to ejaculation. After the middle age the prostate often enlarges. It may project into the bladder and interrupt urination.

**Bulbo-urethral gland** - These are two glands. They are small round masses about 1 cm in diameter. They lie lateral to the membranous urethra. Its secretion may control genito-urinary diseases.

**Scrotum** - It is a fibromuscular sac. It contains the testes and their associated ducts. It is divided into right and left by cutaneous raphe. Its left side is usually lower. The external appearance varies according to age and body temperature. The scrotal skin is thin and pigmented. It has numerous sweat glands and nerve endings.

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## 4. GENETICS

### Part-A

1. ABO blood group in man is an example for
2. Rh. factor in blood was discovered by
3. The type of sex determination in moths and butterflies is
4. X/A ratio in super females is
5. Holandric genes occur exclusively on

- b) multiple allelism
- c) Landsteiner and Wiener
- c) zo - zz type
- a) 1.5
- b) y - chromosomes

### Part - B

Give very short answer.

#### 6. What are multiply alleles ?

- Some genetical characters are determined by several forms of an allele known as multiple alleles.
- Eg ABO blood group

#### 7. Provide the genotypes for himalayan albino rabbits

- ChCh, ChCa - himalayan albino

#### 8. Mention the possible genotypes of the offsprings if the parental blood groups are B and B.

- B x B - B, O

#### 9. What is the cause for the death of a child in erythroblastosis fetalis?

- The presence of Rh<sup>+</sup> child in the uterus of the Rh<sup>-</sup> mother can cause agglutination in the blood of the fetus.
- The death of the foetus in such cases is due to haemolytic anemia.

#### 10. What was the opinion of biometricians in genetics

- Mendelians considered that all hereditary differences are discontinuous and qualitative,
- The biometricians belived that hereditary variations are basically continuous and quantitative.

#### 11. Who are mulattoes?

- Marriages between black and white individuals has resulted in a population known as mulattoes.
- They have intermediate skin colour in the first generation.

#### 12. What is Hermaphroditism?

- A hermaphroditic person will have one extra X and Y chromosome.
- The person will have both ovarian and testicular tissues.
- The external genitalia will not be well defined

#### 13. What is arrhenotokous parthenogenesis?

- It is a common mechanism in several insects such as ants, bees and wasps.
- In these insects, fertilized eggs develop into diploid females and unfertilized egg into haploid males.

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#### 14. What are holandric genes.

-The genes occur exclusively on Y chromosomes are called the holandric genes.

#### Part – C

#### Answer briefly

#### 15. What will be the nature of the F<sub>2</sub> progeny, if a coloured rabbit is crossed with an albino?

- F<sub>2</sub> result shows that coloured condition is dominant over albino.
- Other possible crossings are

F <sub>2</sub>	CC	C <sub>ch</sub>	C <sub>h</sub> C <sub>h</sub>
	25%	50%	25%
	(coloured)	(coloured)	(Himalayan albino)

#### 16. Discuss how 'O' blood group is considered as an universal donor.

- A & B Antigens are absent on RBCs of Blood Group 'O'.
- |                    |                |                              |
|--------------------|----------------|------------------------------|
| <u>Blood group</u> | <u>Antigen</u> | <u>Antibody in the serum</u> |
| O                  | None           | anti A and B                 |
- O Blood group can donate blood to Blood Group O, A, B, AB
- Hence Blood Group O' is Called universal donor.

#### 17. What is erythroblastosis fetalis?

- The presence of Rh- child in the uterus of the Rh- mother can cause agglutination in the blood of the fetus.
- Even though such an unfortunate incident may not happen in the first pregnancy, it could occur in successive pregnancies.
- The death of the foetus in such cases is due to haemolytic anemia.
- This disease is called erythroblastosis fetalis.

#### 18. Write notes on quantitative inheritance.

- The biometricians believed that hereditary variations are basically continuous and quantitative.
- Yule (1906) suggested that quantitative variations may be controlled by large number of individual genes, with each gene having a small effect.

#### 19. Provide an account on Turner's syndrome and Klinefelter's syndrome.

- 1. Turner's syndrome (XO Females) : In this abnormality the females are sterile and have short stature. (44A+XO) Total 45 Chromosomes.
- They have webbed neck, broad shield-shaped chest, low intelligence, under developed breasts and poorly developed ovaries.
- 2. Klinefelter's syndrome :-
- The zygote will have three sex chromosomes (XXY). (44A+XXY) Total 47 chromosome.
- The resulting young one is an abnormal sterile male.
- The symptoms of this syndrome are the presence of small testicles, mental retardation, longer arms and high pitched voice.

#### 20. Describe the process of sex determination in Bonellia

- A larva settling on the proboscis of an adult female becomes a male individual.
- If a larva develops in isolation (ie., in the absence of a female) it develops into female.

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- If a developing male is detached from the proboscis of female, it becomes an intersex.
- From these observations it could be inferred that the proboscis of adult female secretes some hormone like substance and that substance suppresses femaleness and induces maleness in the larvae which remains attached.

#### Part – D

#### Answer in detail

#### 21. Give an account of ABO blood groups in human beings.

- The ABO blood group system in human beings was established by K.Landsteiner.
- It is based on the presence or absence of certain antigens. There can be two antigens A or B in the blood, resulting in four blood groups, namely A,B, AB and O. These are called ABO blood groups or Landsteiner blood groups.
- The inheritance of ABO system illustrates a new principle in genetic control of phenotypes.
- The blood of a person having A group will have the antigen A and a person having B group will have the antigen B. With these antigens A and B there are certain naturally occurring antibodies in the serum of the blood.
- The antibodies in a particular individual will be found only for those antigens which are absent in blood of this individual.

<u>Blood groups</u>	<u>Antigen</u>	<u>Antibody in the serum</u>
A	A	anti B
B	B	anti A
AB	A and B	None
O	None	anti A and B

<u>Blood group of the donor</u>	<u>Blood group of the recipient</u>
A	A and AB
B	B and AB
AB	AB
O	O, A, B, AB

- From the table provided it is obvious that 'group AB' is universal recipient. 'Group O' is universal donor.

#### 22. Explain genic balance mechanism of sex determination.

- Further studies on sex determination showed that sex determination was not the inheritance of genes by the sex chromosomes alone.
- Studies on intersex and supersex indicated the operation of still more a complex mechanism for the determination of sex.
- It was first described by C.B Bridges in 1921.
- In *Drosophila* it was discovered that the sex of an individual depends upon the ratio of x chromosomes to the autosomes.
- For sex determination, each haploid set of autosomes carry factors with a male determining value equal to one (1). Each x chromosome carries factors with a female determining value of one and a half (1.5).
- Hence in a normal male (AAXY), the male female determinants are in the ratio of 2 : 1.5('A' represents a haploid set of autosomes).
- Thus the genic balance is in favour of maleness.
- A normal female (AAXX) has the male female determination ratio of 2:3. Therefore the balance

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is in favour of femaleness.

**23. What is sex - linked inheritance ? Give an account of x - linked inheritance in Drosophila**

- Most of the inheritable characters are controlled by genes located in autosomes.
- The inheritance of traits related to autosomes normally follows Mendel's laws.
- Mendelian ratios are not obtained for those characters for which genes are exclusively located either in X or Y chromosome.
- The genes that occur only on X chromosomes are called as X - linked genes.
- the genes that occur only on Y chromosomes are called holandric genes.
- The inheritance of X or Y linked genes is called as sex linked inheritance.
- Thus the sex linked inheritance may be X- linked, Y- linked or XY linked.

**X - Linked inheritance**

- T. H. Morgan (1910) in his studies on inheritance of genes in Drosophila discovered that the pattern of inheritance of certain traits were found to vary with the sex of the parent and offspring. -
  - He found that the gene for white eye colour is X - linked. Further it was found to be recessive to another
- X - linked, dominant gene for red eye colour.

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## 5.DEVELOPMENTAL BIOLOGY

### Choose the right answer

1. The process of spermiogenesis involves
  2. Centrolecithal eggs are produced by
  3. Discoidal cleavage is seen in the eggs of
  4. Sach's law is related to
  5. The cavity formed in a gastrula is called as
- b) differentiation of spermatids into spermatozoa
  - d) insects
  - a) birds
  - b) cleavage
  - a) gastrocoel

### Give very short answer

#### 1. Provide a list of various stages in the embryology of animals

cleavage, gastrulation, neurulation, organogenesis and the period of growth and histological differentiation.

#### 2. Why do we consider aristotle as the founder of the science of embryology.

Through his remarkable observation and speculations, Aritotle established 'embryology' as an independent field in science. Thus to-day he is regarded as the **founder of the science of embryology**.

#### 3. What are the several diversified fields formed from modern embryology.

Experimental embryology', 'Chemical embryology', 'Comparative embryology' and Descriptive embryology

#### 4. What are microlecithal eggs?

In the eggs of some organisms due to brevity of the growth period the amount of yolk is much reduced. Such eggs are said to be **Microlecithal** or **oligolecithal**. Eg . *Hydra*, *Sea urchin*, *Amphioxus* and **Placental mammals**.

#### 5. What is a morula?

At the final stages of cleavage the embryo acquires a characteristic, mild, oblong shape. In this stage it is called the **morula**.

#### 6. Define meridional cleavage.

The plane of cleavage lies on the animal vegetal axis. It bisects both the poles of the egg. Thus the egg is divided into two equal halves.

#### 7. Mention Balfour's law regarding cleavage

The speed or rate of cleavage in any region of egg is inversely proportional to the amount of yolk it contains.

#### 8. What is a 'fate map' ?

A map showing various organ forming, areas on the blastula is called the '**fate map**'. ,

#### 9. What is involution ?

The inward movement of the exterior cells through the blastoporal region is called **involution**.

### Answer briefly

#### 1. Give an account of the megalecithal egg.

- In some animals the growth and differentiation of the embryo is much more elaborate.
- The growth period is sufficiently long. Hence for supporting the embryo in development the eggs contain large quantity of yolk.
- Such eggs are termed as **Megalecithal** or **Macrolecithal eggs**.eg.Reptiles & Birds eggs

#### 2. What is a centrolecithal egg.

-In **insects** the eggs are oval in shape and the yolk remains in the centre of the egg, its called centrolecithal eggs.



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### **3. Provide a general account on cleavage.**

The process of cleavage remains one of the earliest mechanical activity in the conversion of a single celled egg into a multicellular embryo. It is initiated by the sperm during fertilization.

#### **4. What is sach's law?**

**Sach's laws** - These laws were proposed by Sach in 1877.

- i) Cells tend to divide into equal daughter cells
- ii) Each new division plane tends to intersect the preceding plane at right angles.

#### **5. What are the ectodermal and endodermal derivatives in the organogenesis of frog embryo?**

Ectodermal - Sense organs, ears, lateral sense organs, inner mouth layers, anus, CNS & PNS.

Endodermal - Alimentary canal, lungs, pancreas & urinary bladder.

### **Answer in detail**

#### **1. Provide a detailed account on the types of eggs.**

The eggs can be classified based on amount and distribution of yolk.

##### **(A) Amount of yolk and egg types :**

###### **(1) Microlecithal or oligolecithal**

In the eggs of some organisms due to brevity of the growth period the amount of yolk is much reduced. Such eggs are said to be **Microlecithal** or **oligolecithal**. eg. *Hydra*, *Sea urchin*, *Amphioxus* and **Placental mammals**.

###### **(2) Mesolecithal**

Some eggs with moderate amount of yolk are called **mesolecithal eggs**. Eg. annelid worms, molluscs and amphibians.

###### **(3) Megalecithal or Macrolecithal eggs**

The eggs contain large quantity of yolk. Such eggs are termed as **Megalecithal** or **Macrolecithal eggs**. Eg. Reptiles and birds. These eggs are called **cleidoic eggs** or land eggs.

##### **(B) Distribution of yolk.**

According to the pattern of dispersal of yolk

###### **(1). Homolecithal or isolecithal eggs.**

Eggs of this type have the yolk dispersed in the entire cytoplasm. The distribution is somewhat uniform in animal, vegetal poles and the equatorial region. All microlecithal eggs have this nature. eg. human egg

###### **(2). Telolecithal eggs.**

The eggs having a polarised distribution of yolk in the cytoplasm are referred to as **Telolecithal eggs**. Mesolecithal and macrolecithal eggs remain as telolecithal eggs. Eg. hens egg.

###### **(3). Centrolecithal eggs.**

In **insects** the eggs are oval in shape and the yolk remains in the centre of the egg. .

#### **2. Give an account on the cleavage of fertilized egg.**

-The process of cleavage remains one of the earliest mechanical activity in the conversion of a single celled egg into a multicellular embryo. It is initiated by the sperm during fertilization.

- However in parthenogenetic eggs cleavage can commence without the influence of fertilization.

-The process of cleavage or **cellulation** happens through repeated mitotic divisions.

-These divisions result in cells called **blastomeres**.

-The first cleavage of frog's egg was observed by **Swammerdam** in 1738.

-The entire process of cleavage in frog's egg was studied by **Prevost** and **Dumas** in 1824.

#### **3. Describe how the process of gastrulation occurs in the egg of an amphibian**

- The process of gastrulation is a continuous activity succeeding cleavage.

-During this process the blastodermal cells begin to move. They wander and occupy their prospective organ forming zones.

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- During this movement at one region on the blastula, the cells wander inside and occupy the blastocoelic cavity.
- At a specific region below the equator the blastoderm cells assume an elongated bottle like shape.
- They move toward the interior of the blastula. As the cells move further inside, an invagination happens. A deepening of the invagination results in a cavity called the **archenteron** or **gastrocoel**.
- The opening of the archenteron on the surface of the blastula is called the **blastopore**.
- The blastopore gradually assumes a crescentic shape. Finally it becomes circular. The region dorsal to the blastoporal opening is called the '**dorsal lip**'. The lower edge may be called the '**ventral lip**'.

#### **4. Describe the structural organisation in the neurula of frog.**

- The process of neurulation is the formation of a neural tube.
- However during this process mesoderm and endoderm also undergo differentiation.
- During neurulation the embryo lengthens along the anteroposterior axis.
- The dorsal side of the gastrula is lined by ectodermal cells. The presumptive area of the nervous system gets differentiated from the rest of ectoderm.
- It remains as **medullary plate** or **neural plate**. The neural plate later thickens and it gets raised above the general level as ridges called **neural folds**.
- In the middle of the neural fold a neural groove appears.
- The **neural groove** deepens inside. The neural folds above the groove.
- The neural groove gets converted into a **neural tube**. This tube gets detached from the surface.
- The neural tube remains as the prospective nervous system. The embryo at this stage is called the **neurula**.
- During neurulation, the tubulation of chorda-mesoderm and tabulation of endoderm also happen.
- The post-neurular development of frog involves the formation of all body organs.

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IT IS VERY EASY TO DEFEAT SOMEONE, BUT IT IS VERY HARD TO WIN SOMEONE.  
.....**APJ.ABDUL KALAM..**

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## 6.ECONOMIC ZOOLOGY

Choose the correct answer.

1. Reef forming corals normally grow in -(c) shallow, tropical seas
2. The Great Barrier reef occurs in -(d) the coast of Australia
3. Earthworm commonly employed in Indian vermiculture is -(a) Lampito mauritii
4. The degrades of organic matter by worm activity is -(c) vermicompost
5. The honey bee used commonly in bee-keeping industry is -(c) Apis indica
6. The silk produced by *Bombyx mori* is -(d) mulberry silk
7. The predatory insects are said to be -(a) entomophagous
8. The organization involved in pearl oyster culture is -(b) CMFRI
9. The most common freshwater prawn used in aquaculture is -(a) Macrobrachium sp
10. The name Kal Eral in Tamil refers to -(d) lobsters
11. The fish *Stromateus argenteus* is popularly called as -(b) pomfret
12. Which part of the body in fish provides isinglass -(c) air bladder
13. Which country was economically benefitted by marketing bird excreta -(b) Peru
14. The idea of aquarium maintenance was first conceived by -(a) Chinese
15. Nandankanan Biological park is situated in -(b) Orissa
16. The pneumonic plague affects -(d) lungs
17. Which is the best time to have blood test for filariasis -(d) mid-night
18. The characteristic feature of tail in sea snake is -(c) compressed
19. *Ophiophagus hannah* refers to -(b) King cobra
20. The silver fishes commonly live among -(d) old books

### Part II

Give very short answer

1. What is a fringing reef ?

- **Fringing reefs** form shallow shelves in shallow waters at or near the shore of the mainland or around offshore Islands.

2. Mention the use of vermicompost.

-The breakdown of waste materials or the degrades of organic matter by worm activity is called '**Vermicompost.**' It is a better source of organic manure.

3. How are insects useful to flowering plants in reproduction ?

-Insects play an important role in the pollination of plants. Bees, wasps, ants, butterflies, beetles and thrips render valuable service in pollination.

4. Name any two edible crabs.

*Matuta lunaris*, *Scylla serrata*, *Portunus sanguinolentus*, and *Charybdis cruciata*

5. Provide the names of one live bearer and one egg layer from among the ornamental fishes.

Live bearers

Guppy - *Lebistes reticulatus*

Platy - *Xiphophorus maculatus*

Egg Layers

Siamese fighter - *Betta splendens*

Gold fish - *Carassius carassius*

6. Provide the names of zoos in the states of Tamilnadu and Andhra Pradesh(one

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each).

Arignar Anna Zoological park, Vandalur, Tamil Nadu.

Indira Gandhi Zoological park, Visakha patnam, A. P.

**7. Name the two types of venom released by poisonous snakes**

. One type acts mainly on the nervous system- *neurotoxic*. The other type is *-haemolytic* act on blood.

**8. Provide atleast one major role of CMFRI.**

-The CMFRI in India gives necessary training in pearl culture techniques.

-The central Marine fisheries Research Institute (CMFRI)

**9. Name any two cultivable animals.**

1. Indian prawn-*Penaeus indicus*

2. Indian honey bee-*Apis indica*.

**10. What is *Corallium rubrum* ?**

-Some corals are highly priced for their decorative value.

-Precious corals like *Corallium nobile* (= *C. rubrum*) are used in jewellery and ornaments

**Part III**

**Answer briefly**

**1. What is Biological control ? Explain with an example.**

-Employing insect **predators** and **parasites** for controlling the population of insect pests is known as **biological control**. eg. lady bird beetles (predator)

**2. Provide an account on Indian prawns of commercial importance.**

-Indian prawns-*Penaeus indicus*, *P. monodon*, *P. japonicus*,

-Fresh prawns are packed in ice and sent to inland markets for consumption. Large specimens are frozen directly between layers of ice.

**3. Give an account of cultured pearls.**

-Pearls are one of the rarest and highly esteemed gems. Pearls are produced by the pearl **oysters** of the genus *Pinctada* under class Bivalvia.

-The most important species is *P. fucata*. It has a wide distribution in the Persian Gulf, Red sea, Gulf of Kutch, Gulf of Mannar and the Palk Bay.

**4. Write notes on omega fatty acids.**

-The unique feature which differentiates fish food from other animal protein sources is the presence of omega-3 fatty acids such as **linolenic acid**.

-Omega fatty acid is also good for heart. It helps to control diabetes by improving insulin action.

-It is also reported to be good for arthritis.

**5. What is guano ? comment on its economic importance.**

-Guano is the accumulated excrement or droppings of fish eating sea birds such as gannets, cormorants and pelicans. It has been used as a fertilizer.

-These sea birds populate some islands off the west coast of Peru, lower California and Africa.

**6. Write notes on *Xenopsylla cheopis***

-The insect parasite, *Xenopsylla cheopis* is commonly known as the Asiatic **rat flea**.

-This rat - flea is responsible for the transmission of plague from man to man, or from rat to man.

**7. Give an account on fouling organism.**

-Several aquatic organisms cause damages to submerged surfaces. Since this infestation has an economical importance, several studies are being made.

-Marine sedentary organisms may affect piles, floats, wooden dry docks and boats. These organisms are called **foulers**. Eg. algae, molluscs – mussels.

**8. Draw and label the poison apparatus in a snake.**

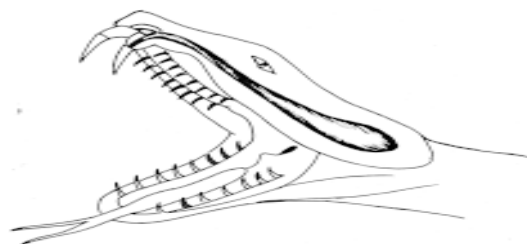
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#### **Part IV**

#### **Answer in detail.**

#### **1. Give an account of insects and insect products of commercial importance.**

##### **I. Productive Insects**

These insects produce certain substances which are useful to humans.

The important useful insect products are **Honey, Silk and Lac**.

##### **A. Honey bee**

-Honey bees are social insects. They live as colonies. They are active throughout the year. They feed on the pollen and nectar of flowers. In India only three species are useful in collecting honey.

1. *Apis dorsata* (Rock bee). 2. *Apis florea* (small bee) 3. *Apis indica* : (Indian honey bee)

**Uses of honey**: 200g of honey provides as much nourishment as 11.5 litres of milk or 1.6kg cream or 330g meat. One gram of honey provides approximately 33k.cal of energy. It is helpful in building up the haemoglobin of the blood. It prevents cough, cold, and fever. It cures ulcers on tongue and alimentary canal.

##### **B. Silk worms**

The silk is obtained as fine threads from the cocoons of various species of silkworms. **Sericulture** is the scientific management of production and marketing of natural silk from silkworms.

##### **Types of Silk worms**

1. Mulberry silkworm - *Bombyx mori*, 2. Tasar Silk worm : *Antheraea paphia*

3. Muga Silk worm: *Antheraea assamensis*, 4. Eri Silk worm : *Attacus ricinii*

##### **Uses of silk**

-The raw silk is used in the manufacture of woven materials, knitted fabrics and garments. It is also used in parachutes, parachute cords, fishing lines, as sieves in flour mills, insulation coil for telephones and wireless receivers, and tyres of racing cars.

##### **C. Lac insects**

Another useful product we get from insects is **lac**. Lac is the resinous protective secretion produced by a kind of scale insect called *Laccifer lacca*. They secrete a brown resinous substance called the **lac**.

##### **Uses of lac**

Lac is one of the most versatile natural resinous material. It has a unique combination of properties which render it useful in the plastics, electrical, adhesive, leather, wood finishing and other industries.

#### **2. What are the nutritive values of fishes.**

The nutritive and medicinal value of fish have been recognized from time immemorial. Fish flesh is an excellent source of protein in human diet. The principal biochemical contents of fish flesh are protein, fat



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and water. Protein constitutes about 20 percent. The nutritional value of fish flesh is comparable and even higher than that of the flesh of birds and mammals. Fish flesh remains a good source for all essential aminoacids in needed concentrations.

### **Medical and Economic importance of fish**

Apart from direct consumption, contents in the body of fish are processed into a number of valuable products.

#### **Fish liver oil**

Fish liver contains vitamin A and D in considerable quantities. Eg. shark liver oil and cod liver oil. Fish liver oil can cure or prevent occurrence of deficiency diseases such as rickets, xerophthalmia, impaired vision and eye defects, abnormalities in skin, mucous membrane and vertebrae. Fish liver oil will ensure healthy growth of bones and teeth.

#### **Fish body oil**

Fish body oil is obtained from the entire body of fish. Fish body oil is generally extracted from oil sardines or from less edible varieties of fishes. It is also extracted from wastes discarded from fishery industries.

#### **Fish Meal :**

Fish meal is the cooked, ground and dried preparation of the fish body. It makes an excellent poultry and animal feed. It enhances egg and milk production.

#### **Fish flour :**

Fish flour is considered an ideal protein source to supplement diet of both adults and infants. It may also be mixed with wheat and maize flour. It is also used to enrich bakery products such as cakes, breads, biscuits, soup and sweets.

#### **Omega Fatty acid**

The unique feature which differentiates fish food from other animal protein sources is the presence of omega-3 fatty acids such as **linolenic acid**, **docosahexaenoic acid (DHA)** and **eicosapentaenoic acid (EPA)**. DHA promotes learning ability in children and improved memory in elders. DHA is essential for the foetal growth and development. Omega fatty acid is also good for heart. It helps to control diabetes by improving insulin action. It is also reported to be good for arthritis.

### **3. Give a detailed account on setting up an aquarium and maintaining the same.**

#### **Setting up an aquarium tank**

**Tank selection** : The choice of an aquarium tank, depends largely on where it is to be housed, the extent of one's enthusiasm and the money one wants to spend. While selecting a tank it is very important to note that it is of good construction. If the tanks are purchased they should be checked for leakage. Their sides should be cleaned with 1 % potassium permanganate solution, besides repeated washing with tap water. The next step in the setting up of an aquarium is the collection of sand that is necessary to make the bed at the bottom of the tank.

#### **Quality of water for Aquarium tank**

Rain water free from contaminants or tap water is ideal for aquarium tanks. A tap water of domestic supply is likely to have chlorine which is harmful to fish. The tank should be filled with the desired water without disturbing the bottom sand.

**Planting** : The aquarium tank after being filled with water can be planted with selected varieties of aquatic plants. such as **Vallisneria** and **Myriophyllum**.

**Lighting** : Light besides beautifying the aquarium helps in the photosynthesis of aquarium plants. Fishes also require light to trace their food.

#### **Introduction of fish in an aquarium tank.**

The number of fishes suitable for stocking in an aquarium tank depends mainly on the surface area of the tank, its dissolved oxygen content and size of the fish. It is reported that 1 cm long fish may need about 75 cm<sup>2</sup> of the surface area. Based on the above, a tank of 75 X 30 cm size for example may hold three fishes each of 10 cm length.



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### **Feeding**

Algae which often grow around stones and in water serve as a good food source to swordtails, kissing gourami and mollies. Live protein rich foods such as tubifex worms, Chironomid larvae and mosquito larvae are considered excellent. Artificial fish feed meant only for aquarium fishes can also be used.

### **Common ornamental fishes**

#### **Live bearers**

Guppy - *Lebistes reticulatus*

Platy - *Xiphophorus maculatus*

#### **Egg Layers**

Siamese fighter - *Betta splendens*

Angel fish - *Pterophyllum scalare*

Gold fish - *Carassius carassius*

### **4. Write an essay on insect pests of stored products and household goods**

#### **Pests of Stored grains**

##### **a. Rice weevil - *Sitophilus Oryzae***

This is a very serious major pest of stored grains in farm storage. It is worldwide in distribution. generally, infestation starts in grains only during storage which may lead to heat spots in the grain. The grains are hollowed and the weight is reduced.

##### **b. Khapra beetle - *Trogoderma granarium***

Khapra beetle is a very serious pest of wheat and other stored grains all over India. Only the larval stage is destructive, adult beetle being harmless. The grubs attack the germ portion of the grain. In severe infestation the cereals are reduced to mere frass.

##### **c. Pulse beetle - *Callosobruchus Chinensis***

This is a very important pest of various pulse crops in India. It affects both in fields and in stores. The pest attacks leguminous pods in the field from where they are carried to godowns. The larvae bore into the pulses and grains. They feed and grow inside. The damaged grains are unfit for human consumption.

#### **Pests of household goods**

##### **a. Termites (white ants) - *Odontotermes obesus***

The food of termites consists primarily of wood (cellulose). This habit of termites is the cause for very serious losses, particularly in tropical countries. They destroy wood work, furnitures, buildings, fences and other wooden structures that come into contact with the soil.

The losses caused by termites to Indian agriculture and other commercial crops like wheat, barley, maize, gram, sugarcane, groundnut, several vegetables, fruit trees and coconut .

##### **b. Silverfish - *Lepisma saccharina***

It is cosmopolitan in distribution. It is commonly found living in moist warm places and among old books. It is a whitish wingless insect of about 13 mm in length. It mostly attacks old books and magazines. It infests starched clothes, rayon fabrics, book labels or bindings where glue has been used.

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## 7. ORIGIN OF LIFE

### Part - A

1. The resistant spores that led to origin of life on earth are named as - **b) cosmozoa**
2. The proposal that living forms are animated forms of non-living matter was provided by - **d) Aristotle**
3. The protocell model was formed of - **a) coacervates**
4. Mesozoic era is commonly referred to as - **c) golden age of reptiles**
5. The first vertebrates were included in the group - **b) Agnatha**
6. The duration of cenozoic era was - **a) 210 to 65m years ago**
7. The coal and petroleum are obtained from the forests of - **a) Devonian period**
8. The earliest ancestor of horses were - **a) Eohippus**
9. Fossils of woolly mammoths were obtained from - **a) Siberia**
10. Identify the early ancestor of horses - **d) Hyracotherium**

### Part – B

#### 1. What was the nature of the primordial earth according to J.B.S Haldane ?

-Life originated on earth, when the atmosphere was devoid of O<sub>2</sub> gas. Today's earth is surrounded by oxygen and its derivative ozone.

-molecules gradually accumulated in the oceans as a dilute 'soup'.

#### 2. Why do we call the palaeozoic era as the cradle of ancient life.

- Palaeozoic era saw the origin and the radiation of several groups of animals and plants that remained as the forefathers for the modern groups. Thus this era is known as the **Cradle of ancient life.**

#### 3. What was Archeopteryx ?

-The first birds originated from the reptiles. The earliest bird thus originated is known as the **Archeopteryx.**

#### 4. What is 'ice age' ?

- Several glaciations happened during **Pleistocene epoch** time. This epoch is popularly called the 'Ice age'.

#### 5. What is dating of fossils ?

- The age of the fossils to a large extent can be assessed accurately, using radioisotope method. It is known that all elements exist as isotopes. Eg. C<sup>12</sup>, C<sup>14</sup>.

#### 6. What is the significance of seymouria ?

- **Seymouria** - Interconnecting link between Amphibians and Reptiles

#### 7. What is Mac Arthur's law ?

- According to 'Mac Arthur's law' as every new adaptation encourages the survival of a possessor it also decreases a fitness of other related species of that area.

#### 8. What is precambrian period ?

-The period preceding cambrian is known as **Pre-cambrian period.**

-During precambrian time simple algae, protozoans, poriferans, annelids, were well established.

### Part C

#### 1. What is abiogenesis ?

-The theory that life originated from non-living material is now called **abiogenesis.**

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-An earlier version of this theory was **spontaneous generation** or the origin of life without apparent cause.

- philosophers like Thales, Empedocles and Aristotle supported this concept.

## **2. Give an account of Urey-Miller hypothesis.**

-U.S scientists Harold Urey and Stanley Miller in 1950's proposed and attempted to prove that amino acids can be synthesised outside living systems.

-They conducted experiments in which a gas mixture containing hydrogen, ammonia, methane and water vapour was subjected to electric spark.

-This trial yielded aldehydes, amino acids and carboxylic acids

## **3. What is the evolutionary significance of fossils?**

-1. Fossils tell us the full story of evolution. Fossil studies reveal the course of evolution.

2. Through fossils the origin and evolution of specific groups of organisms can be understood e.g. Horse evolution.

3. Fossils provide us clues regarding climatic conditions of various prehistoric periods.

4. Study of fossils simplifies phylogenetic discussions.

## **4. Give an account of the significant events of the Palaeozoic era.**

-This era is known as the **Cradle of ancient life**.

### **Events of Palaeozoic era**

1. **Cambrian period** :-, 2. **Ordovician period** :- 3. **Silurian period**, 4. **Devonian Period** :-

5. **Mississippian Period**, 6. **Pennsylvanian**, 7. **Permian Period**

## **5. Give an account of various epochs included in Cenozoic era.**

1. **Paleocene epoch**, 2. **Eocene Epoch**, 3. **Oligocene epoch**, 4. **Miocene epoch**, 5. **Pliocene Epoch**,

6. **Pleistocene epoch**.

## **Part D**

### **1. Give an account of the Mesozoic era.**

#### **II. Mesozoic Era :-**

This middle period in the history of life was marked by the prominence of land living forms. Among animals the reptiles became more dominant. They increased in size and in number. Hence this era is named as the **Golden age of reptiles**.

1. **Triassic Period** :- (210 to 160 million years ago)

For the first time fossils of turtles, crocodiles, and dinosaurs have been obtained from this period. Fossil evidences show that aquatic and flying reptiles thrived during this time. The mammals originated from reptiles during this period.

2. **Jurassic Period** :- (160 to 130 million years ago)

There was a marked adaptive radiation among dinosaurs. They diversified into carnivorous and herbivorous forms. The first birds originated from the reptiles. The earliest bird thus originated is known as the **Archaeopteryx**.

3. **Cretaceous Period** :- (130 to 65 million years ago)

The larger marine molluscs became extinct. The fossils of such organisms are available in places like Ariyaloor, of Tamil Nadu, today. The Dinosaurs of the Mesozoic era abruptly became extinct during this period. Several reasons are given for the extinction of the dinosaurs. Fossils of dinosaurs were not obtained from later periods.

### **2. What is mass extinction ? Provide the causes for such extinctions.**

#### **Mass Extinction**

-Extinction may be defined as the termination of a lineage without issue or abrupt disappearance of specific groups of organisms without leaving descendants.

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-Extinctions are of two types namely true extinctions and pseudo extinction.

-In true extinctions a particular lineage totally disappears without any progeny or evolutionary descendants.

-Pseudo extinction may also be called as **phyletic extinction** or **phyletic transformation**

-In horse evolution while the earliest ancestor **Eohippus** became extinct its descendent survived to produce the modern '**Equus**'.

-Extinctions can happen for the taxonomic groups such as a family or genus. Thus the extinction of dinosaurs as a group is a case of true extinction.

#### **-Causes of extinction :-**

Even though extinctions are regular events in the history of earth they are caused due to specific reasons

(1) A mass extinction may be due to drastic changes in the environmental conditions.

(2) Any adaptive advance in one species decreases the fitness of all other species. Thus according to Red Queen's hypothesis you have to keep running pretty fast, just in order to stay in the same place.

(3) Over specialisation to a specific situation may cause extinction.(ex. Antlers.)

(4) The spread of an epidemic disease without any control can cause extinction.

(5) An increase in the population strength of herbivorous animals can cause rapid food shortage and cause extinction for several inter-related groups.

(6) A sudden cosmic radiation can cause the death of large organisms.

(7) A dust storm formed due to falling of a meteorite is commonly mentioned as a cause for the disappearance of dinosaurs.

### **3. Write an essay on fossils and methods of fossilization.**

#### **Fossils**

The fossils are the preserved remains of animals, plants or their parts found in various strata of earth.

Fossils may be of entire organisms or a part which got buried, a mould or cast, foot prints or imprints of a leaf on a stone.

**Fossilization :-** Fossils can result by several methods. However these methods are purely accidental.

There are many methods of fossilization.

1. **Petrifaction :-** It is the commonest method. In this method dead and buried organisms turn into stones. This is due to formation of sedimentary rocks under water. .

2. **Petrifaction of soft parts :-** Under certain conditions muscles and other soft organs may get mineralised and form rocky fossils. Several such plant fossils had been obtained.

3. **Preservation of foot prints :-** Moving animals on soft mud can leave foot prints. A study of such imprints can provide clues regarding the body form and characteristics of the extinct animal.

4. **Moulds and casts :-** Fossilized moulds are found in volcanic ashes. Several invertebrate fossils had been obtained as moulds. They provide details about the exact physical features of the animal.

5. **Fossilization in resins and amber :-**

Normally, insects get entangled in soft sticky secretions of trees called resin. The dried material can get fossilized. These fossils can even reveal the colour of the organism.

6. **Preservation in ice :-** Entire animals can get frozen and may be preserved in ice. In such fossils the body parts remain intact without change.

7. **Dating of fossils :-** The age of the fossils to a large extent can be assessed accurately, using radioisotope method. It is known that all elements exist as isotopes. Isotopes are atoms having slightly different atomic weights. e.g  $C^{12}$  and  $C^{14}$ .

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