DATE : 14/03/2020

SET-2

Code No. 57/5/2

Aakash
Medical | IIT-JEE | Foundations
(Divisions of Aakash Educational Services Limited)

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Time : 3 Hrs.

Max. Marks : 70

Class XII

Biology (Theory)

(CBSE 2020)

GENERAL INSTRUCTIONS :

*(i) Question paper comprises five sections **A, B, C, D** and **E.***

(ii) There are 27 questions. All questions are compulsory.

*(iii) Section **A** contains question number **1** to **5**, multiple choice questions of **one** mark each.*

*(iv) Section **B** contains question number **6** to **12**, short answer type-**I** questions of **two** marks each.*

*(v) Section **C** contains question number **13** to **21**, short answer type-**II** questions of **three** marks each.*

*(vi) Section **D** contains question number **22** to **24**, short answer type-**III** questions of **three** marks each.*

*(vii) Section **E** contains question number **25** to **27**, long answer type questions of **five** marks each.*

*(viii) There is no overall choice in the question paper, however, an internal choice has been provided in **two** questions of **one** mark, **one** questions of **two** mark, **two** questions of **three** marks and **three** questions of **five** marks questions. In these questions, an examinee is to attempt any one of the **two** given alternatives.*

(ix) Wherever necessary, the diagram drawn should be neat and properly labelled.

Section-A

1. In a bacterium when RNA-polymerase binds to the promoter on a transcription unit during transcription, it **[1]**

(a) terminates the process

(b) helps remove introns

(c) initiates the process

(d) inactivates the exons

Answer (c)

Sol. In a bacterium, RNA-polymerase enzyme binds to the promoter sequence of transcription unit and initiate the transcription process. **[1]**

2. The first cellular form of life evolved **[1]**

(a) in air

(b) on land

(c) in water environment

(d) in deep soil

Answer (c)

Sol. The first cellular form of life evolved in water and they were chemoheterotrophs. **[1]**

3. Mating of a superior male of a breed of a cattle to a superior female of another breed is called [1]

(a) in breeding (b) out crossing

(c) out breeding (d) cross breeding

Answer (d)

Sol. The type of breeding in which a superior male of one breed is mated with a superior female of another breed is called cross breeding.

eg. *Hisardale* is a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Merino rams. [1]

OR

Large-holes in 'Swiss-Cheese' are due to [1]

(a) *Propionibacterium sharmanii* (b) *Saccharomyces cerevisiae*

(c) *Penicillium chrysogenum* (d) *Acetobacter aceti*

Answer (a)

Sol. Swiss-Cheese is ripened with the help of a bacterium called *Propionibacterium sharmanii*. [1]

4. Increased concentration of DDT in fish eating birds is due to [1]

(a) eutrophication (b) bio-magnification

(c) cultural eutrophication (d) accelerated eutrophication

Answer (b)

Sol. Pesticides such as D.D.T are non-biodegradable and once they are absorbed by an organism, they gets accumulated in fat containing tissues in increasing concentrations along the food chain. [1]

OR

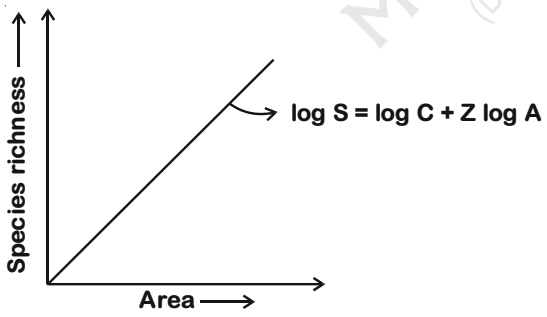
Species-Area relationship is represented on a log scale as [1]

(a) hyperbola (b) rectangular hyperbola

(c) linear (d) inverted

Answer (c)

Sol. On the log scale the relationship becomes linear



[1]

5. Which one of the following part of the plant when put into the soil is likely to produce new offspring? [1]

(a) Part of an internode (b) A stem cutting with a node

(c) Part of a primary root (d) A flower

Answer (b)

Sol. A stem cutting with a node has axillary bud due to which it likely to produce new offspring when put into soil. [1]

Section-B

6. Name the Scientists and write how did they explain Mendel's laws after the chromosomes were discovered. [2]

Sol. Chromosomal theory of inheritance was proposed independently by **Sutton and Boveri.** [½]

They united the knowledge of chromosomal segregation with Mendelian principles and told that-

Like the hereditary traits the chromosomes retain their number, structure and individuality throughout the life of an organism and from generation to generation. [½]

Both chromosomes as well as genes occur in pairs in the somatic or diploid cells. They segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete.

A gamete contains only one chromosome of a type and only one of the two alleles of a trait. [½]

The paired condition of both chromosomes as well as Mendelian factors is restored during fertilization.

Thus, homologous chromosomes synapse during meiosis and then segregate independently into different cells which establish the quantitative basis for segregation and independent assortment of hereditary factors. [½]

7. State two advantages of an apomictic seed to a farmer. [2]

Sol. Advantages of an apomictic seed to a farmer :

(1) Production of hybrid seeds is costly and hence seeds become expensive for farmer. Whereas if these seeds are made apomictic they become cost effective. [1]

(2) If hybrids seeds are made apomictic then the farmers can use to raise new crop every year without buying hybrid seeds every year. [1]

8. List two diseases that spread through inhaling droplets or aerosols. Write one prominent symptoms for each one of them. [2]

Sol. Two diseases that spread through inhaling droplets or aerosols are

(i) Pneumonia

(ii) Common cold [1]

The symptoms of pneumonia include fever, chills and cough. In severe cases, the lips and finger nails may turn gray to bluish in colour. (Any one symptom) [½]

The common cold is characterised by nasal congestion and discharge, sore throat, hoarseness, cough, tiredness, etc. (Any one symptom) [½]

9. What makes humus a reservoir of nutrients? Name and write about the process humus undergoes that enriches the soil. [2]

Sol. Colloidal nature of humus make them reservoir of nutrients. [1]

Humus is degraded by microbes and inorganic nutrients are released in soil. This process is called mineralisation. [1]

10. (a) Name the two techniques employed to meet the increasing demand of fish in the world.

(b) Name any two fresh water fishes. [2]

Sol. (a) The two techniques employed to meet the increasing demand of fish in the world are

(i) Aquaculture, (ii) Pisciculture [½+½=1]

(b) Fresh water fishes are

(i) *Catla,* (ii) *Rohu,* (iii) Common carp (Any two) [½+½=1]

OR

Describe the contributions of Alexander Fleming, Ernest Chain and Howard Florey in the field of microbiology. **[2]**

Sol. Alexander Fleming discovered first antibiotic penicillin while working on *Staphylococcus* bacteria. **[1]**

Full potential of penicillin as an effective antibiotic was established by Ernest Chain and Howard Florey. Fleming, Chain and Florey were awarded the Nobel Prize in 1945 for discovery of penicillin. **[1]**

11. All cloning vectors do have a 'selectable marker'. Describe its role in recombinant DNA-technology. **[2]**

Sol. **Selectable marker :** All cloning vectors require a selectable marker, which helps in **identifying** and **eliminating non-transformants** and **selectively permitting** the growth of the transformants. **[1]**

Normally, the genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline or Kanamycin, *etc*. are considered useful selectable markers of *E. coli*. **[1]**

12. Mention how have plants developed mechanical and chemical defence against herbivores to protect themselves with the help of one example of each. **[2]**

Sol. Plants have developed several mechanical and chemical defence against herbivore such as :

(a) **Mechanical defence** : Thorns are the most common mechanical means of defence. eg. *Acacia* **[1]**

(b) **Chemical defence** : Chemicals produced by some plants make herbivore sick when they are eaten, inhibit feeding or digestion, disrupt its reproduction or even kill it. eg. *Calotropis* producing glycosides. **[1]**

Section-C

13. Explain 'Integrated organic' farming as successfully practiced by Ramesh C. Dagar, a farmer in Sonepat (Haryana). **[3]**

Sol. Integrated organic farming is a cyclical, zero-waste procedure, where waste products from one process are cycled in as nutrients for other processes. Ramesh Chandra Dagar, a farmer in Sonipat, Haryana, is doing just this. He includes bee-keeping, dairy management, water harvesting, composting and agriculture in a chain of processes, which support each other and allow an extremely economical and sustainable venture. There is no need to use chemical fertilisers for crops, as cattle excreta (dung) are used as manure. Crop waste is used to create compost, which can be used as a natural fertiliser or can be used to generate natural gas for satisfying the energy needs of the farm. **[3]**

14. Explain three different modes of pollination that can occur in a chasmogamous flower. **[3]**

Sol. (i) **Autogamy :** In this type, pollination is achieved within the same flower. Transfer of pollen grains from the anther to the stigma of the same flower. **[1]**

(ii) **Geitonogamy :** Transfer of pollen grains from the anther to the stigma of another flower of the same plant. **[1]**

(iii) **Xenogamy :** Transfer of pollen grains from anther to the stigma of a different plant. This is the only type of pollination which during pollination brings genetically different types of pollen grains to the stigma. **[1]**

OR

Explain the formation of placenta after implantation in a human female. [3]

Sol. Formation of placenta :

(i) After implantation, finger-like projections appear on the trophoblast called chorionic villi. [1]

(ii) Chorionic villi are surrounded by the uterine tissue and maternal blood. [1]

(iii) The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal blood called placenta. [1]

15. You are asked to find the genotypes of a tall pea plant growing in your school garden. Name the cross and explain how would you confirm the genotypes. [3]

Sol. To know the genotype of tall pea plant we have to perform test cross.

In a typical test cross, an organism showing a dominant phenotype is crossed with the recessive parent type. [1]

If the tall plant is homozygous, then the result will be as follows :

Parents TT × tt

Offspring Tt 100% tall [½]

If the tall plant is heterozygous, then the result will be as follows :

Parents Tt × tt

	t	t
T	Tt	Tt
t	tt	tt

Offspring 50% Tall, 50% Dwarf [½]

Therefore, if 100% offspring of this cross are tall, then the tested tall plant is homozygous and if only 50% are tall, then the tested tall plant is heterozygous. [1]

16. What are 'SNPs'? Where are they located in a human cell? State any two ways the discovery of SNPs can be of importance to humans. [3]

Sol. SNPs are single nucleotide polymorphism. [1]

At about 1.4 million locations SNPs are located in humans. [1]

SNPs promises to revolutionise the processes of finding chromosomal locations for disease associated sequences and tracing human history. [½ + ½]

17. What is adaptive radiation? Explain with the help of a suitable example. [3]

Sol. Adaptive radiation: The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. [1]

Example: Darwin's finches exemplify adaptive radiation. Darwin went to Galapagos island. There he observed small black birds which were later called Darwin's finches. He realised that there were many varieties of finches in the same island. All the varieties, he conjenctured, evolved on the island itself. From the original seed-eating features, many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches. Thus, they exhibit adaptive radiation. [2]

18. (a) Explain the mode of action of Cu^{++} releasing IUDs as a good contraceptive. How is hormone releasing IUD different from it?

(b) Why is 'Saheli' a preferred contraceptive by women (any two reasons)? **[3]**

Sol. (a) Copper IUDs commonly called Copper-Ts have ionised copper which slowly diffuses at the rate of some 50 μg/day. IUDs increase phagocytosis and the Cu ions suppress sperm motility and their ability to fertilize the ovum. **[1]**

Hormone releasing IUDs such as LNG-20 release small quantities of hormones and make the uterus unsuitable for implantation and cervix hostile to sperms. **[1]**

(b) **Saheli**, the new oral contraceptive for the females contains a non-steroidal preparation called centchroman. It is a 'once a week' pill with very few side effects and a high contraceptive value. **[1]**

19. (a) Explain why bee-hives are setup on the farms for some of our crop-species. Name any two such crop species.

(b) List any three important steps to be kept in mind for successful bee keeping. **[3]**

Sol. (a) Keeping beehives in crop fields during flowering period increases pollination efficiency and improves the yield-beneficial both from the point of view of crop yield and honey yield. **[½]**

Eg., Sunflower, *Brassica*, Apple and Pear. **[Any two examples ½+½ = 1]**

(b) The following points are important for successful bee-keeping :

(i) Knowledge of the nature and habits of bees,

(ii) Selection of suitable location for keeping the beehives,

(iii) Catching and hiving of swarms (group of bees),

(iv) Management of beehives during seasons, and

(v) Handling and collection of honey and of beeswax. **[Any three - 1½] [½+½+½ = 1½]**

20. Explain the role of *Agrobacterium tumifacience* in developing resistance in tobacco plant against nematode *Meloidegyne incognitia*. Name the processes responsible for this. **[3]**

Sol. *Meloidegyne incognitia* infects the roots of tobacco plants and causes reduction in yield.

To protect the tobacco plant from this infection, *Agrobacterium* is used as vector.

Using *Agrobacterium*, nematode-specific genes are introduced into the host plant.

The introduction of DNA is such that it produces both sense and anti-sense RNA in the host cells. The two RNA's being complimentary to each other form a double stranded (dsRNA) that silences the specific mRNA of the nematode.

Thus the parasite, *Meloidogyne incognitia* cannot survive in the transgenic host expressing specific interfering RNA. Therefore, the transgenic plant is protected from parasite. **[2]**

This process of mRNA silencing is called RNA interference which develops resistance in tobacco against *Meloidogyne incognita* (RNAi) **[1]**

21. Differentiate between "Pioneer-species"; "Climax-community" and "Seres". **[3]**

Sol. The first biotic species that develops in a bare area is termed as 'pioneer species'. E.g., Lichens on rock, Phytoplanktons and Zooplankton in pond. **[1]**

The last community in biotic succession which is relatively stable and is near equilibrium with the environment of that area is called 'climax community'. e.g., Forests **[1]**

Whole sequence of events occuring in biotic succession is called 'sere' **[1]**

OR

Explain any three ways other than zoological parks, botanical gardens and wildlife safaries, by which threatened species of plants and animals are being conserved 'ex situ'. **[3]**

Sol. Following are the three ways other than zoological parks, botanical gardens and wildlife safaries by which threatened species of plants and animals are being conserved '*ex-situ*':-

1. **Cryopreservation :** It is technique by which gametes of threatened species can be preserved in viable and fertile condition for long periods at liquid nitrogen temperature (– 196°C). **[1]**
2. **Seed bank :** It is one of the *ex-situ* conservation strategy in which seeds of different genetic strains of commercially important plant can be kept for long periods. **[1]**
3. **Tissue culture :** It is a process by which part of plants can be propagated (micropropagation).

[1]

Section-D

22. Following a road accident four injured persons were brought to a nearby clinic. The doctor immediately injected them with tetanus antitoxin.

(a) What is tetanus antitoxin ?

(b) Why were the injured immediately injected with this antitoxin ?

(c) Name the kind of immunity this injection provided. **[3]**

Sol. (a) Tetanus antitoxin contains preformed antibodies against tetanus antigen and is directly injected into the body. **[1]**

(b) Injured were immediately injected with this antitoxin because there is likelihood of infection with deadly tetanus bacteria due to entry of spores through an open wound which can even prove fatal. **[1]**

(c) The injection of tetanus antitoxin provides artificial passive immunity. **[1]**

23. "The population of a metro city experiences fluctuations in its population density over a period of time".

(a) When does the population in a metro city tend to increase?

(b) When does the population in metro city tend to decline?

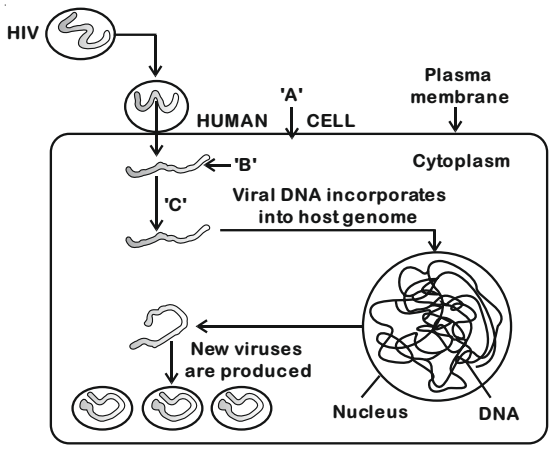
(c) If 'N' is the population density at the time 't', write the population density at the time 't + 1'. **[3]**

Sol. (a) When resources in the metro cities (habitat) are unlimited, each species has the ability to realise its innate potential to grow in number. Hence, population in metro cities tend to increase. **Immigration** is another cause. **[1]**

(b) When resources present in the environment are limiting, the population in metro cities (habitat) tends to decline. Emigration is another cause. **[1]**

(c) $N_{t+1} = N_t + [(B + I) – (D + E)]$ **[1]**

24. Study the diagram showing the entry of HIV into the human body and the processes that are followed:



(a) Name the human cell 'A' HIV enters into.

(b) Mention the genetic material 'B' HIV releases into the cell.

(c) Identify enzyme 'C' [3]

Sol. (a) HIV enters into the human cells called Macrophages that act like a HIV factory [1]

(b) HIV virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with help of enzyme reverse transcriptase. [1]

(c) Enzyme 'C' is reverse transcriptase [1]

Section-E

25. (a) Why did T.H. Morgan select *Drosophila melanogaster* for his experiments?

(b) How did he disprove Mendelian dihybrid F_2 phenotypic ratio of 9 : 3 : 3 : 1 ? Explain giving reasons.

[2 + 3]

Sol. (a) T.H. Morgan selected *Drosophila melanogaster* for his experiments due to following reasons:

Drosophila can be grown on simple synthetic medium in the laboratory. [½]

They complete their life cycle in about two weeks, and a single mating can produce a large number of progeny flies. [½]

There is a clear differentiation of the sexes – the male and female flies are easily distinguishable. [½]

It has many types of hereditary variations that can be seen with low power microscopes. [½]

(b) Morgan carried out several dihybrid crosses in *Drosophila* to study genes that were X-linked. The crosses were similar to the dihybrid crosses carried out by Mendel in peas.

At first cross, he crossed yellow-bodied (y) and white-eyed (w) female with brown-bodied (y^+) red-eyed (w^+) male and got F_1 generation in the form of brown-bodied red-eyed female and yellow-bodied white-eyed male. In F_2 generation, obtained by intercrossing of F_1 hybrids, the ratio deviated significantly from expected. He found 98.7% to be parental and 1.3% as recombinants. [1]

In a second cross, between white-eyed and miniature-winged female (wwmm) with wild red-eyed (w^+) normal-winged male (m^+) the F_1 generation included red-eyed normal-winged female and white-eyed miniature-winged male. After intercrossing the F_1, progeny was found to be 62.8% parental and 37.2% recombinant type. [1]

In both of the crosses, he observed that the two genes did not segregate independently of each other and the F_2 ratio deviated very significantly from the 9 : 3 : 3 : 1 ratio. Phenotypic ratio as 9 : 3 : 3 : 1 in F_2 generation is obtained in dihybrid cross if both genes are showing independent assortment.

Morgan and his group knew that the genes in both crosses were located on the X-chromosome (*i.e.*, same chromosome). [½]

Morgan attributed this due to the physical association of the two genes to describe the physical association of genes on same chromosome and to describe the generation of non-parental gene combinations.

Morgan observed that recombinant types were low (1.3%) in cross A as compared to cross B, it means genes for white eye and yellow body were very tightly linked. Genes for white eye and miniature wing were loosely linked as they showed comparatively higher recombination (37.2%). [½]

OR

(a) List any four major goals of Human Genome Project.

(b) Write any four ways the knowledge from HGP is of significance for humans.

(c) Expand BAC and mention its importance. **[2 + 2 + 1]**

Sol. (a) **Goals of HGP** **[2]**

Some of the important goals of HGP were as follows:

(i) Identify all the approximately 20,000-25,000 genes in human DNA.

(ii) Determine the sequences of the 3 billion chemical base pairs that make up human DNA.

(iii) Store this information in databases.

(iv) Improve tools for data analysis.

(v) Transfer related technologies to other sectors, such as industries.

(vi) Address the ethical, legal, and social issues (ELSI) that may arise from the project.

[Any Four]

(b) Knowledge of HGP has great significance for humans as given below. **[2]**

(i) There are more than 1200 genes that cause common cardiovascular ailments, endocrine disease like diabetes, Alzheimer's disease, cancers and other neurological ailments. After taking their snapshots, it will be possible to know the method to alter them and remove the possibility of the disorders.

(ii) Single gene defects produce a number of hereditary diseases, that can be corrected.

(iii) It will be possible to study interactions between various genes, proteins, as well as mechanism of forming tissues, organs, tumours or switch over to different developmental stages.

(iv) It holds promise of healthier and longer living, designer drugs and genetically modified diets according to needs of individual human beings.

(c) BAC $\rightarrow$ Bacterial artificial chromosomes. **[1]**

It is a vector which is used to amplify the DNA fragment within the suitable host.

26. (a) Name the insect that attacks cotton crops and causes lot of damage to the crop. How has Bt cotton plants overcome this problem and saved the crop? Explain.

(b) Write the role of gene *Cry IAb*. **[5]**

Sol. (a) Cotton bollworm attacks cotton crops and causes lot of damage to the crop **[1]**

Bt cotton plant contains the gene coding for Bt toxin which is produced by *Bacillus thuringiensis*. The toxin is coded by a gene *Cry IAc* named *cry*. *Bacillus Thuringiensis* forms protein crystals during a particular phase of their growth. **[1]**

These crystals contain a toxic insecticidal protein. The Bt toxin protein exists as inactive protoxin but once an insect ingests the inactive toxin, it is converted into an active form of toxin due to alkaline pH of gut which solubilise the crystals. **[1]**

The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually causes death of insect. **[1]**

(b) *Cry IAb* codes for proteins that control corn borer. **[1]**

OR

(a) Explain the different steps carried out in Polymerase Chain Reaction, and the specific roles of the enzymes used.

(b) Mention application of PCR in the field of

(i) Biotechnology

(ii) Diagnostics **[5]**

Sol. (a) Each cycle of polymerase chain reaction (PCR) has three steps :

(i) **Denaturation :** Starting solution is heated usually to 94°C that breaks double stranded DNA helix, providing single-stranded templates. **[1]**

(ii) **Primer annealing :** Reaction mixture is cooled to 50° – 60°C to provide temperature for primers to bind to their complementary ss DNA template. **[1]**

(iii) **Extension of primers :** Sample is heated to 72°C, during which DNA polymerase adds nucleotides to primer, synthesising a new DNA strand. **[1]**

Repeated amplification is achieved by the use of a **thermostable DNA polymerase** called *Taq* polymerase (isolated from a bacterium, *Thermus aquaticus*), which remain active during the high temperature induced denaturation of dsDNA.

(b) (i) **Application of PCR in Biotechnology :**

PCR is used for DNA amplification and the amplified fragment if desired can be used to ligate with a vector for further cloning. **[1]**

(ii) **Application of PCR in Diagnostics :**

By using PCR diseases like phenylketonuria, muscular dystrophy, sickle cell anaemia, AIDS, tuberculosis etc. can be diagnosed. **[1]**

27. (a) Explain the process of syngamy and triple fusion in angiosperms.

(b) Trace the development of the product of syngamy upto its mature stage in a dicot plant.

(c) Draw and label three important parts of a mature dicot embryo. **[5]**

Sol. (a) Angiosperms exhibit the unique event of double fertilisation. Here two types of fusion occur such as

(1) Syngamy : One male gamete fuses with egg to form zygote.

♂	+	♀	⟶	Zygote
male gamete		egg		
(n)		(n)		(2n)

(2) Triple fusion : Other male gamete fuses with secondary nucleus (fused polar nuclei) to form primary endosperm nucleus (PEN)

♂	+	Two fused	⟶	PEN
male gamete		Nuclei		
(n)		(2n)		(3n)

[1+1]

(b) Syngamy ⟶ Zygote ⟶ Globular embryo ⟶ Heart shaped embryo ⟶ Mature dicot embryo **[1]**

(c)

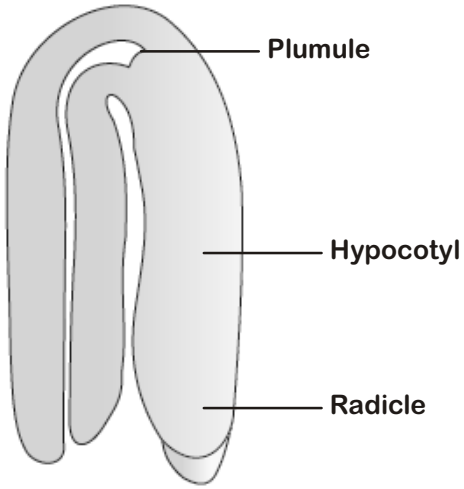


Figure – [½]

Labelling – [½ × 3]

OR

Name the gonadotropins in human. Explain their role in human male and female, respectively. **[5]**

Sol. Both FSH and LH synthesized from anterior lobe of pituitary gland are collectively known as gonadotropins. Synthesis of both FSH and LH starts at puberty under control of GnRH from hypothalamus **[1]**

In males, LH acts on the Leydig cells of testes and stimulates synthesis and secretion of androgens. **[1]**

FSH in males acts on the Sertoli cells and stimulates secretion of some factors which help in spermiogenesis. **[1]**

In females, secretion of gonadotropins (FSH and LH) increases gradually during follicular phase and stimulates follicular development and secretion of estrogen. **[1]**

LH surge in females induces rupture of Graafian follicle and release of ovum (ovulation). **[1]**

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