

Biology

Academic Year: 2017-2018

Marks: 70

Date & Time: 6th March 2018, 11:00 am

Duration: 3h

Question 1.1: The phenotypic ratio of incomplete dominance is _____. [1]

2 : 1

1 : 2 : 1

1 : 1 : 1

1 : 1 : 2

9 : 3 : 3 : 1

1 : 1

3 : 1

Solution: 1 : 2 : 1

In incomplete dominance, both alleles are expressed partially and one gene does not suppress the expression of the other gene. As a result, the two heterozygotes are similar phenotypically and genotypically; hence, the genotypic and phenotypic ratio observed in the F₂ generation is 1:2:1.

Question 1.2: Nucleoside is a nucleotide without _____. [1]

(A) Sugar

(B) Nitrogen base

(C) Hydrogen bond

(D) Phosphate group

Solution: Phosphate group

Question 1.3: Which of the following is white button mushroom? [1]

(A) *Agaricus bisporus*

(B) *Pleurotus Florida*

(C) *Volvariella volvacea*

(D) *Candida species*

Solution: *Agaricus bisporus*

Question 1.4: Brown rust of wheat is caused by _____. [1]

viruses

bacteria

fungi

aphids

Solution: Brown rust of wheat is caused by fungi.

Question 1.5: The reaction centre of P.S. II is _____. [1]

- (A) Chl-a, 700
- (B) Chl-a, 680
- (C) Chl-a, 673
- (D) Chl-a, 650

Solution: Chl-a, 680

Question 1.6: The enzymes required for synthesis of ATP are located on [1]

- (A) oxysomes
- (B) cristae
- (C) matrix
- (D) ribosomes

Solution: oxysomes

Question 1.7: In a food chain, the herbivores are represented by [1]

- (A) producers
- (B) primary consumers
- (C) secondary consumers
- (D) decomposers

Solution: primary consumers

Question 2.1.1: What is leaching? [1]

Solution: Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts is leaching.

Question 2.1.2: Define chemoautotrophs [1]

Solution: Chemoautotrophs are those who make their own food by deriving the energy from chemical reactions. e.g., Nitrifying bacteria, Iron bacteria etc.

Question 2.1.3: Name the cell organelle in which Krebs' cycle occurs. [1]

Solution: Krebs' cycle occurs in the matrix of mitochondria

Question 2.1.4: What is deforestation? [1]

Solution 1: Deforestation is the conversion of forested areas to non-forested ones.

Solution 2: The permanent removal, decrease or deterioration of forests and woodlands chiefly by human activities is deforestation.

Question 2.1.5: Give the microbial source of Vit. B₁₂ [1]

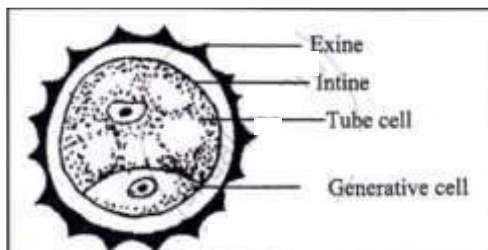
Solution : Pseudomonas denitrificans is the microbial source of Vit. B₁₂

Question 2.1.6: What is primary treatment of sewage? [1]

Solution : Filtration and sedimentation [Physical process] to remove floating debris and heavy particles respectively are primary treatment of sewage.

Question 2.2: Sketch and label a pollen grain of angiosperms [2]

Solution :



Question 2.3.1: Enlist the basic steps involved in recombinant DNA technology [1]

Solution: 1) Isolating genomic DNA of a 'donor'. The cell or organism from which the required gene is taken is called 'donor'.

2) Fragmenting this DNA using "molecular scissors" (Restriction endonuclease Enzymes).

3) Screening the fragments for a 'desired gene'.

4) Inserting the fragments with the desired gene into a 'cloning vector'. (a plasmid, cosmid, or phage DNA) so as to develop a recombinant DNA or chimeric DNA.

5) Introducing the recombinant vector into a competent host cell

6) Culturing these cells to obtain multiple copies or clones of the desired fragment of DNA

7) Using these copies to "Transform" suitable host cells so as to express the desired gene

Question 2.3.2: Give two examples of microbial pesticides with their hosts. [1]

Solution:

Pathogen	Host range
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Bacteria : Bacillus thuringiensis(Bt)	Caterpillars (larvae of moths and butterflies), larvae of Aedes, black flies, some adult beetles, wax moths, etc.
Fungi : Beauveria bassiana	Aphids, mealy bugs, mites, white files, etc.
Protozoans : Nosema locustae	Grasshoppers, caterpillars, some corn-borers and crickets
Viruses : Nucleopolyhedrovirus or NPV (125 types known)	Gypsy moths and caterpillars

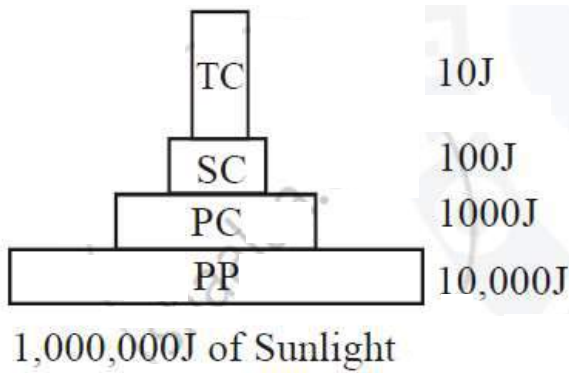
Question 2.3.3: Give the significance of respiration [1]

Solution:

- 1) Respiration provides energy for biosynthesis of cellular materials such as carbohydrates, proteins, fats, lipids, vitamins, pigments, etc
- 2) It is also a source of energy for cell division, growth, repairs and replacement of worn out parts, movements, locomotion etc.
- 3) Various intermediates of Krebs cycle are used as building blocks for the synthesis of other complex compounds.
- 4) Coupled with photosynthesis, it helps to maintain the balance between CO₂ and O₂ in the atmosphere
- 5) Anaerobic respiration (fermentation) is used in various industries such as dairies, bakeries, distilleries, leather industries, paper industries, etc. It is used in the commercial production of alcohol, organic acids, vitamins, antibiotics etc.
- 6) The energy of respiration is also used to convert insoluble substances into the soluble form.

Question 2.3.4: Explain energy pyramid [1]

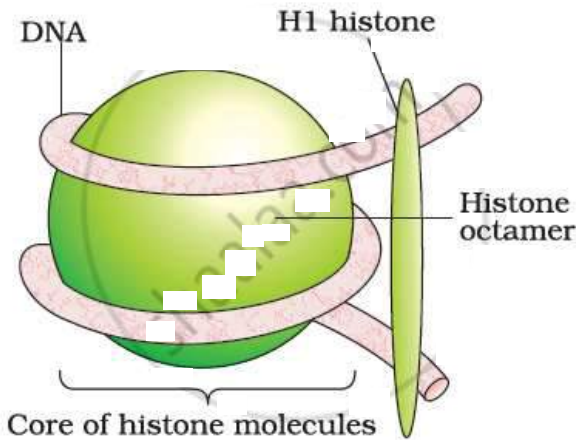
Solution: Pyramid of energy is always upright, it can never be inverted. When energy flows from a particular trophic level to the next, some energy is lost as heat at every step. There is the unidirectional flow of energy. The energy captured by autotrophs does not go back to the solar input or the energy which passes to herbivores does not go back to autotrophs. As the energy flows progressively through various trophic levels it is no longer available to the previous trophic level



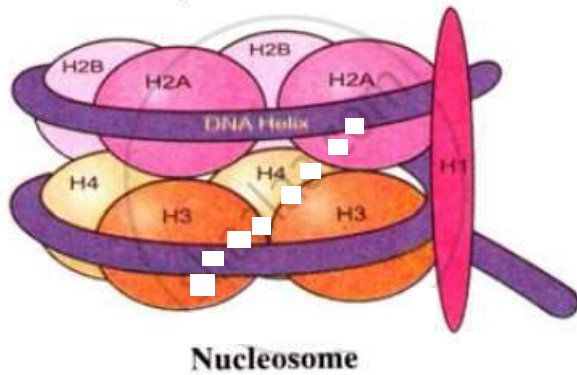
Pyramid of energy

Question 3.1.1: Describe the structure of a nucleosome. [2]

Solution 1: In eukaryotes, the packaging of DNA helix is very complex, as the amount of DNA is very high. When we analyze the structure of eukaryotic chromosome, we find that it is composed of DNA and proteins. These proteins, known as **histones**, are basic in nature and are positively charged. Thus, they can easily interact with the negatively charged DNA molecule. The histone proteins first organise to make a unit of eight molecules, which is known as histone octamer. The negatively charged DNA molecule gets wrapped around this positively charged histone octamer. This complex structure is called nucleosome. In a typical nucleosome, around 200 base pairs of DNA are present.



Solution 2: The nucleosomes in chromatin are seen as 'beads-on-string'. Histones are proteins that are rich in the basic amino acid residues like lysines and arginines which carry the positive charge in their side chains. Eight molecules of histones (two each of H2A, H2B, H3 and H4) get organized to form histone octamer. DNA is negatively charged and it is wrapped around the positively charged histone octamer to form the nucleosome. Around the octamer, DNA molecule is wrapped as 1 and 3/4th turn. The DNA is called core DNA (146 bp) and small segments of DNA linking octamer are called linker DNA (54 bp). Each nucleosome contains 200 bp of DNA helix.



Question 3.1.2: Describe the steps of PCR technique. [2]

Solution 1: One cycle of Polymerase Chain Reaction involves three basic steps:

a. Denaturation b. Annealing c. Polymerization

a. Denaturation:

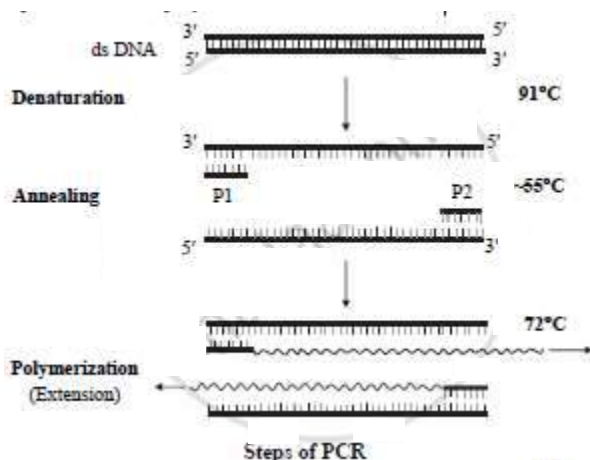
The desired DNA is heated to a high temperature of about 91°C and forms a single stranded DNA. It results in the separation of the two strands of DNA, each of which would function as a template for the synthesis of a new molecule of DNA.

b. Annealing:

1. It is the process in which the two primers (oligonucleotides) hybridise to each of the strands of DNA. It requires a temperature of 55°C.

c. Polymerization:

In this step, the Taq polymerase carries out the synthesis of DNA region between the two primers by using deoxyribonucleotides (dNTPs) and Mg²⁺. The optimum temperature for this polymerization reaction is 72°C.



Solution 2: The three essential steps of PCR technique are -

1) **Heat denaturation:** This step involves heating of DNA at about 91°C. The heating breaks the hydrogen bonds to make ssDNA. The DNA molecule with more G-C pairs needs the higher temperature.

2) **Annealing:** It is pairing of primers to the ssDNA segment. The primers have to be designed as per the requirement. This step requires temperature at about 55°C

3) **Polymerisation:** The temperature is raised to 72°C. The Taq polymerase adds dNTPs behind the primer on the ssDNA. These three steps constitute one cycle of the reaction (3-5 mins). The process is carried out for about 28-30 cycles beyond which its reliability decreases.

Question 3.1.3: Describe different steps involved in tissue culture technique [2]

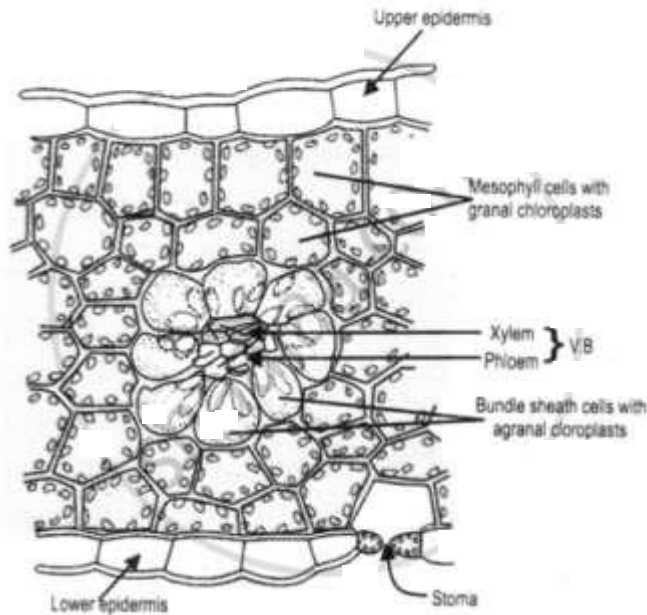
Solution: 1) **Explant culture:** Proper explant is excised from the plant which may be a cell, tissue or a piece of the plant organ. Generally, parenchyma tissue or meristem is used as explants. The cells from explant absorb nutrients and start multiplying to form callus. Callus is the unorganised mass of cells

2) **Sterilization:** In tissue culture technique, different apparatus, the medium used and the explant also is to be properly sterilized to avoid the contamination due to which the experiment may fail. The methods used for sterilization may be dry or wet sterilization, Alcohol sterilization etc. The explants used can be sterilized by using 1% sodium hypochlorite or 70% ethyl alcohol or 10% hydrogen peroxide

3) **Organogenesis:** Now the growth hormones like auxins and cytokinins in proper proportion are provided to the callus to induce the formation of organs. If auxins are more, roots are formed (rhizogenesis) and if the cytokinins are in more quantity then the shoot system begins to develop (caulogenesis).

Question 3.2: Sketch and label T. S. of a leaf showing Kranz anatomy. [2]

Solution:



T.S of leaf Showing Kranz anatomy

Question 4.1: With the help of a neat and labelled diagram describe the development of female gametophyte of angiosperms. [7]

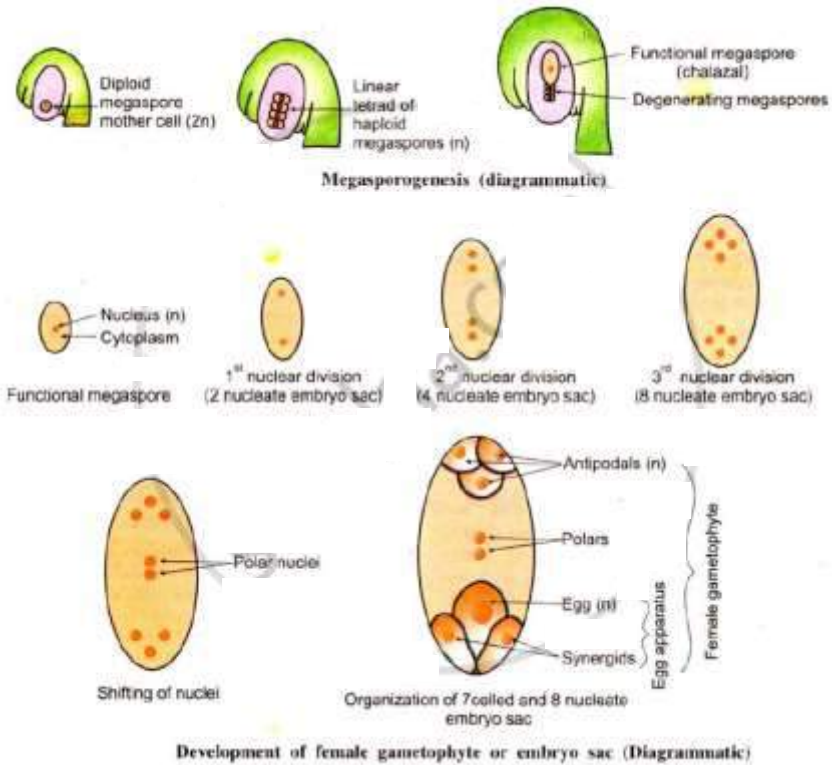
Solution: A diploid hypodermal cell at the micropylar end of nucellus gets differentiated to form archesporium. Mostly this single-celled archesporium directly functions as megaspore mother cell (MMC). This diploid MMC ($2n$) undergoes meiosis to form a tetrad of haploid megaspores (n).

This process is known as megasporogenesis. Megaspores are generally arranged in the linear tetrad.

Generally, the chalazal megaspore remains functional while three degenerate gradually. Functional (fertile) megaspore is the first cell of the female gametophyte. It undergoes enlargement and develops into a female gametophyte. The haploid nucleus of functional megaspore undergoes three successive free-nuclear mitotic divisions.

First mitotic division results in the formation of two nuclei. Both the nuclei undergo two successive divisions. This results in the formation of four nuclei at each pole and an 8-nucleated structure is formed. One nucleus from each pole comes to the centre and they function as polar nuclei.

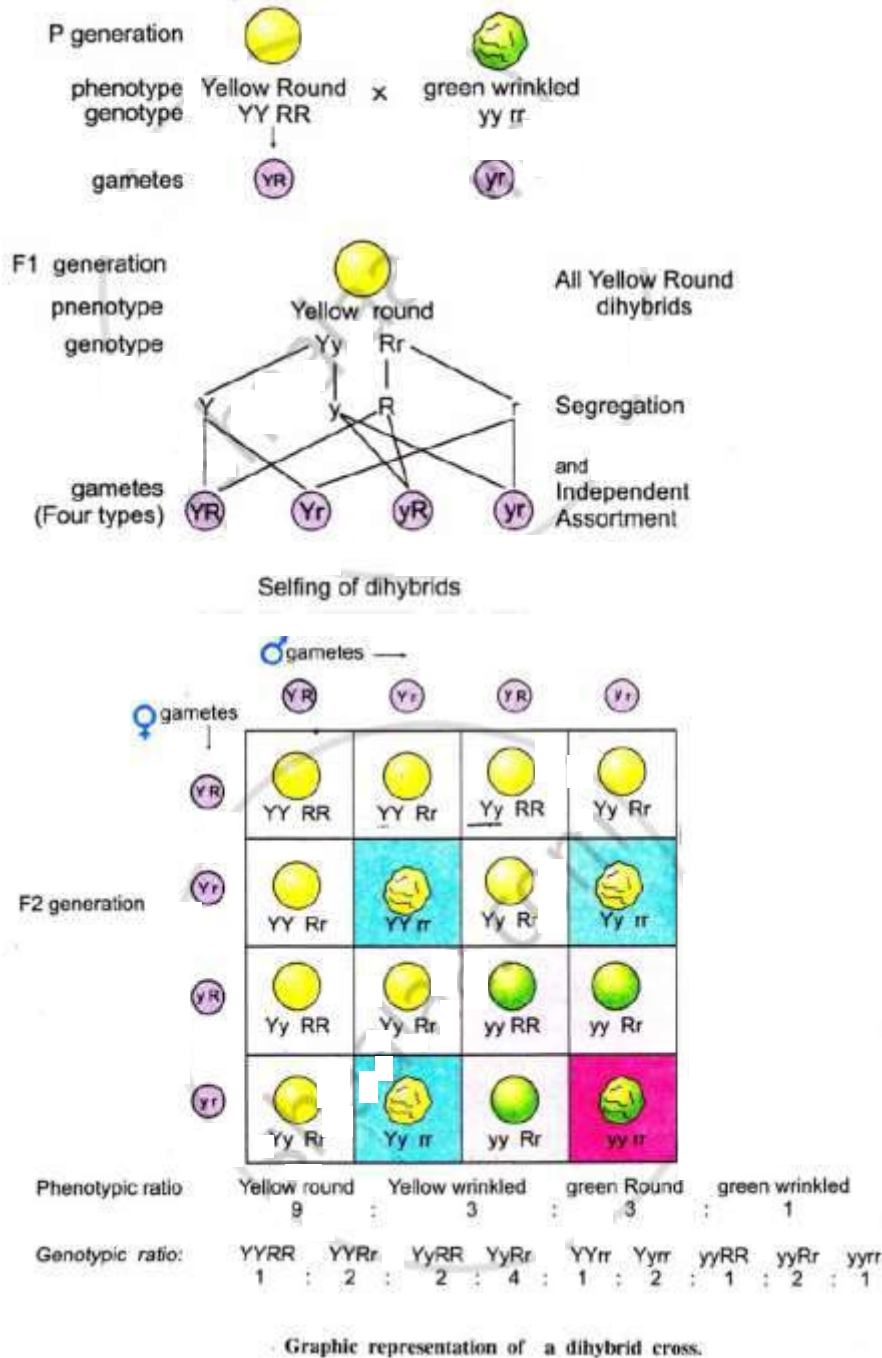
This is followed by the cellular organization to form 3-celled egg apparatus at micropylar end, three antipodals at the chalazal end and two polar nuclei remain in the centre. Thus, 8-nucleated, 7-celled female gametophyte is formed within the functional megaspore; therefore the development is called endospores. Only one megaspore takes part in the formation of embryo sac; therefore it is called monosporic. (In some Angiosperms, embryo sac may be bisporic or tetrasporic).



Question 4.2: Explain the law of independent assortment with a suitable example. [7]

Solution: When the two homozygous parents differing in two pairs of contrasting traits are crossed, the inheritance of one pair is independent of the other. In other words, when a dihybrid (or poly hybrid) form gametes, assortment (distribution) of alleles of different traits is independent of their original combinations in the parents. This law of independent assortment can be explained with the help of dihybrid cross and dihybrid ratio. The appearance of new combinations in F₂ generation proves the law.

Carry out dihybrid cross for any two characters till F₂ generation with the phenotypic and genotypic ratio



Explanation :

A gamete that receives 'Y' for colour may receive 'R' for shape or 'r' for shape. This would result in the formation of YR and Yr types of gametes. Similarly, a gamete that receives 'y' for colour may receive 'R' or 'r' for shape. This would result in the formation of yR and yr types of gametes (Independent assortment).

Question 5.1: _____ is used for desalination of brackish water [1]

(A) Reverse osmosis

- (B) Ion – exchange
- (C) Adsorption
- (D) Electrodialysis

Solution: Reverse osmosis

Question 5.2: Which of the following is mesodermal in origin? [1]

- (A) Retina
- (B) Enamel of teeth
- (C) Heart
- (D) Liver

Solution: Heart

Question 5.3: _____ is an exotic breed of cow [1]

- (A) Gir
- (B) Sindhi
- (C) Sahiwal
- (D) Jersey

Solution: Jersey

Question 5.4: _____ maintains basic metabolic rate. [1]

- (A) Thyroxine
- (B) ADH
- (C) GH
- (D) Oxytocin

Solution: Thyroxine

Question 5.5: Which of the following is an example of ZW – ZZ type of mechanism of sex determination? [1]

- (A) Honeybee
- (B) Fish
- (C) Bird
- (D) Human being

Solution: Bird

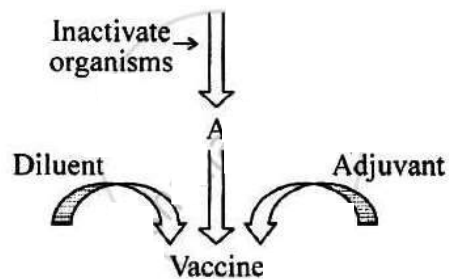
Question 5.6: Transfer of gene between the population that differ genetically from one another is called _____. [1]

- (A) Gene mutation
- (B) Gene flow

- (C) Genetic drift
- (D) Genetic recombination

Solution: Gene flow

Question 5.7: In the given diagram of vaccine manufacturing process 'A' is _____. [1]



- (A) Antigen
- (B) Antibody
- (C) Antitoxin
- (D) Antibiotics

Solution: Antigen

Question 6.1.1: Longer toes and long prehensile tail indicate which adaptation? [1]

Solution: Longer toes and long prehensile tail indicates arboreal adaptation

Question 6.1.2: What does IUCD indicate? [1]

Solution:

IUCD – means intra uterine contraceptive device. This a barrier / mechanical contraceptive method. e.g. CuT (Copper T), LNG – 20 etc

Question 6.1.3: Name of the valve between the left atrium and left ventricle and give its significance. [1]

Solution: Bicuspid or mitral valve is present between the left atrium and left ventricle. It prevents the backflow of blood from ventricles to auricle or atrium.

Question 6.1.4: Give the use of bovine growth hormone [1]

Solution: Bovine growth hormone increaes milk production.

Question 6.1.5: State any two symptoms of Down's syndrome. [1]

Solution: Symptoms of Down syndrome are as follows :

- 1) Most children showed typical facial features with a fold of skin (epicanthal skin fold) over the inner corner of the eye. This results in downward slanting of eyelids
- 2) The face is typically flat and rounded flat nose, mouth open and tongue protruding
- 3) Mental retardation
- 4) Due to poor skeletal development, they have short stature and relatively small skull, the palate is arched.
- 5) Flat hand with characteristic crease which runs all the way across the palm (simian crease).

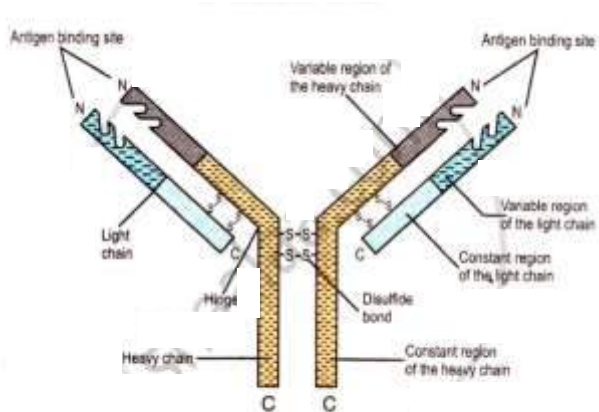
Question 6.1.6: Distinguish between ape and man. [1]

Solution:

	Ape		Man
1	Apes possess a prognathous face, slanting forehead and snout protruded with a flat nose.	1	Humans possess an orthognathous face, high forehead, dome shaped skull and elevated nose.
2	They have a cranial capacity of 400–600 c.c.	2	They have a cranial capacity of approximately 1450 c.c.
3	The chin is absent.	3	A prominently developed chin.
4	Locomotion is quadrupedal.	4	Locomotion is bipedal.

Question 6.2: Sketch and label structure of Antibody [2]

Solution:



Structure of Antibody

Question 6.3.1: Name the causative organism and preventive measures for Typhoid [2]

Solution 1: Typhoid – Salmonella typhi

These measures include proper community sanitation, cleaned and chlorinated water supply system and personal cleanliness. Prevention of food contaminated by flies and dust. Cooks and food handlers in eating establishments should be pressed upon to wash their hands with soap and water before food handling.

Solution 2: Typhoid – Salmonella typhi

These measures include proper community sanitation, cleaned and chlorinated water supply system and personal cleanliness. Prevention of food contaminated by flies and dust. Cooks and food handlers in eating establishments should be pressed upon to wash their hands with soap and water before food handling.

Question 6.3.2: State the economic importance of lac culture. [2]

Solution: Production of lac plays the vital role in the economy of farmers. It is used in bangles, toys, woodwork, polish, inks, silvering mirrors.

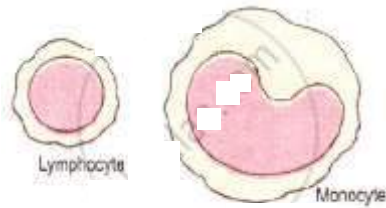
Question 6.3.3:

All organisms produce more young ones. Comment

Solution: Every living organism has a great potential for reproduction. All organisms produced more young ones than those which can survive up to maturity. In other words, any population tends to increase in geometrical proportion. The sole purpose of organisms is to survive and perpetuate the species.

Question 6.3.4: Describe agranulocytes with the help of diagrams. [2]

Solution:



Agranulocytes

Agranulocytes show absence of granules in the cytoplasm and the nucleus is not lobed. They are of two types viz.

- 1) Lymphocytes – They show round nucleus, constitute about 25 – 33 % of total WBC and are responsible for immune response of the body
- 2) Monocytes – They show large kidney-shaped nucleus, constitute about 3 – 9% of total WBC and are phagocytic in function

Question 7.1.1: Define the following term and give one example for each: [2]

Parasitism

Solution 1: Parasitism is a kind of relationship between two species in which one species which is termed as parasite, derives its food from the other species which is termed as host. Parasitism also involves shelter, in addition to food obtained by a parasite. Parasites may be ectoparasites or endoparasites. Ectoparasites live on the surface of their host while endoparasites live inside the body of the host.

Examples of Parasitism

- (i) Cuscuta growing on shoe flower plant: Cucuta grows on the stem of shoe and derive nutrition from the plant.
- (ii) Head lice is an ectoparasite and suck human blood
- (iii) Ascaris, Taenia, Plasmodium causing diseases in humans
- (iv) Koel laying its eggs in crow's nest is an example of Brood parasitism. Birds lay egg in the nest of its host and host incubate it.

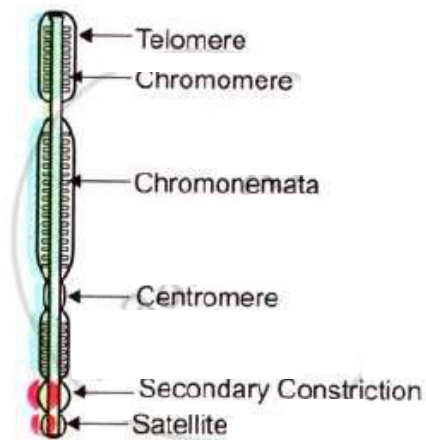
Solution 2: Parasitism:

Parasitism is the interaction in which only one species (parasite) is benefited and the interaction is detrimental to other species (host).

Question 7.1.2: Describe the structure of chromosomes with a suitable diagram. [2]

Solution: Chromosomes are filamentous bodies present in the nucleus and are visible during cell division. A metaphasic chromosome has 2 identical halves called sister chromatids. Each chromatid is in turn made up of sub chromatids called chromonemata (singular – chromonema). The chromatids lie side by side and are held together at one point called the centromere. The centromere is also called the primary

constriction. During cell division, the spindle fibres are attached at the centromere. Besides the primary constriction, additional narrow areas called secondary constrictions are present. Some of the secondary constrictions are called nucleolar organizers because they are necessary for the formation of the nucleolus. The part of the chromosome beyond the nucleolar organizer is short, spherical and is called satellite. The tip of the chromosome is called telomere. It has a unique property in that it prevents the ends of the chromosomes from sticking together but attaches to the nuclear envelope. The surface of a chromosome bears the number of small swellings called chromomeres.



Structure of Chromosome

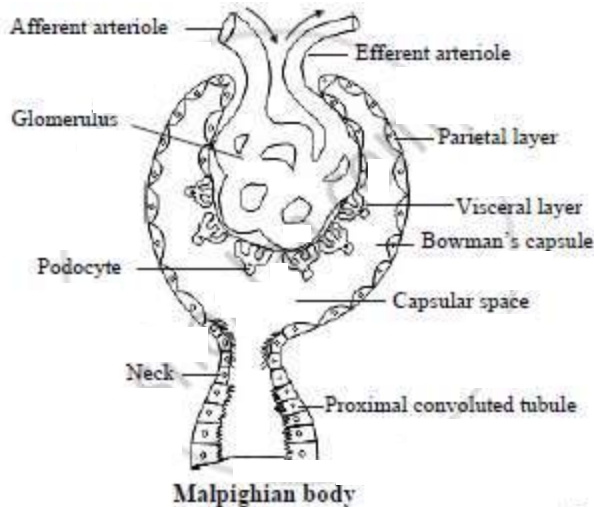
Question 7.1.3: Define 'genomics'. Give any 'two' applications of it. [2]

Solution:

Genomics is the study of the molecular organization of the genome. Human genome project (HGP) is aimed to produce the map of human genome. These maps help in the understanding location of genes, functions, distance between different genes and nucleotide sequence of each gene. HGP reveals that 99.9 % of genes are same in all individuals and only 0.001% difference is seen in DNA. Biotechnological applications for human health – Insulin is a hormone which regulates blood glucose level. In Diabetes mellitus patients, due to hyposecretion of insulin by pancreas, blood sugar level increases. Insulin is produced by using biotechnological methods. Vaccines are antigenic preparation which stimulates production of antibodies and induce immunity against several diseases.

Question 7.2: Sketch and label the structure of Malpighian body. [3]

Solution:



Question 8.1: Describe the T.S. of human testis [3]

Solution 1: Externally, each testis is covered by three layers. These are:

a. Tunica vaginalis:

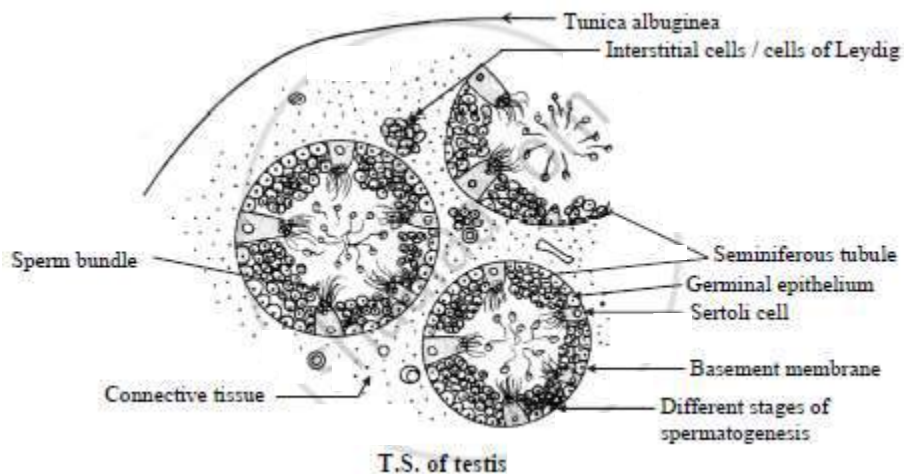
It is the outermost incomplete peritoneal covering made up of connective tissue and epithelium.

b. Tunica albuginea:

It is the middle layer formed by fibrous connective tissue.

c. Tunica vasculosa:

It is the innermost layer formed of delicate connective tissue, supporting a network of blood capillaries.



ii. Each testis contains about 200-300 tubules called seminiferous tubules.

iii. These are lined by a single layer of cuboidal germinal epithelium which undergo spermatogenesis.

- iv. In the germinal epithelium, various stages of spermatogenesis such as spermatogonia, primary spermatocytes, secondary spermatocytes, spermatids and sperms are seen.
- v. Between these cells, few large and pyramidal cells called nurse cells or sertoli cells are present.
- vi. Bundles of sperms are seen attached to Sertoli cells.
- vii. These cells provide nourishment to the sperms till maturation.
- viii. In between seminiferous tubules, connective tissue containing blood vessels, nerves, lymph vessels and groups of interstitial cells (Cells of leydig) is present.
- ix. Interstitial cells produce male hormone testosterone.

Question 8.2: Draw labelled diagrams of the following: Eye [3]

Solution 1:

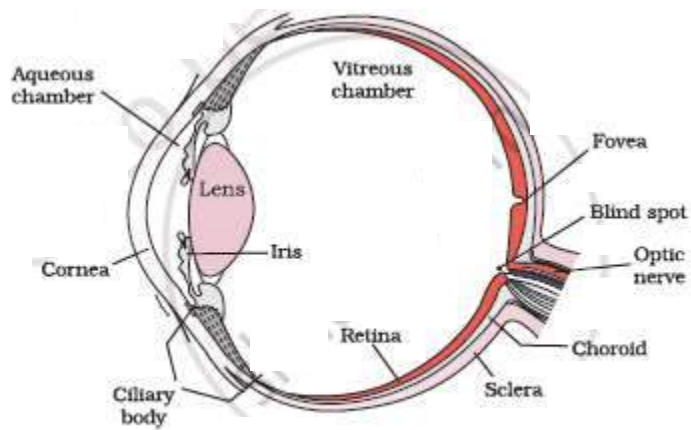
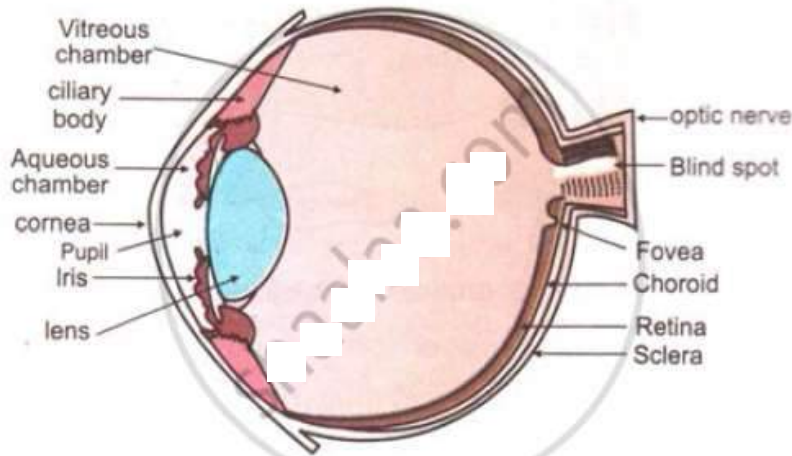


Diagram showing parts of an eye

Solution 2:



Anatomy of Human Eye

Describe the anatomy of the human eye.

Solution: A pair of eyes is located in sockets of the skull known as orbits. The human eyeball is nearly a spherical structure. The wall is formed by three layers. The outer layer of dense connective tissue forms sclera. The transparent anterior portion of this layer is termed as the cornea. A thin transparent membrane called conjunctiva is present in front of the cornea. The middle layer is called choroid which is bluish in colour and contains many blood vessels. The posterior two – third region of this layer is thin, while the anterior part is thick and forms the ciliary body. Forward segment of the ciliary body is pigmented and opaque known as iris. This is the visible coloured portion of the eye. A transparent crystalline lens is present anteriorly which is held in position by suspensory ligaments. The aperture surrounded by the iris in front of the lens is known as the pupil. The movement of the pupil is regulated by the muscle fibres of iris.

The retina is the innermost layer of the eye. It consists of three sub-layers, ganglion cells, bipolar cells and photoreceptor cells sensitive to light. The photoreceptor cells contain light-sensitive proteins termed as photopigments. Photoreceptor cells are of two types, rods and cones. The cones are responsible for daylight vision and colour vision while rods function in dim light. The purple-red protein called rhodopsin is present in the rods which is a vitamin A derivative. The cones are of three types that respond to red, green and blue light. Various combinations of these cones and their photopigments produce the sensation of different color. The sensation of white light is produced due to simultaneous equal stimulation of all these three types of cones.

The optic nerve leaves the eye at a point slightly away from the median posterior pole of the eyeball. The rods and cones are absent in these regions and hence it is known as the blind spot. A yellowish pigmented spot called macula lutea is present lateral to the blind spot with a central pit termed as the fovea. It is thinned out the portion of the retina where only the cones are densely packed and therefore have the greater visual

acuity. The aqueous chamber is a space between the cornea and the lens. It contains a thin watery fluid known as aqueous humour. The larger space between the lens and the retina is termed as the vitreous chamber. It is filled with the transparent gelatinous fluid known as vitreous humour. The aqueous humour and vitreous humor maintains the shape of the eyeball.

Explain the mechanism of vision.

Solution: Mechanism of vision :

The light rays from the object pass through the cornea and the lens. These are focused on the retina of the eye. The rods and the cones contain photopigments which are conjugated proteins. They are composed of opsin and retinol. The light induces dissociation of retinol from the opsin resulting in changes in the structure of opsin. This causes a change in the permeability of retinal cells. It generates an action potential which is carried via bipolar neurons and ganglion cells and further conducted by the optic nerves to the visual cortex of the brain. The neural impulses are analyzed and the image formed on the retina is recognized.