

# Biology

Academic Year: 2015-2016

Marks: 70

Date & Time: 4th March 2016, 11:00 am

Duration: 3h

**Question 1: Select and write the most appropriate answer from the given alternatives for each sub-question [7]**

**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 F<sub>2</sub> generation is 1:2:1.

**Question 1.2:** The number of purines in a segment of DNA molecule is 68. What will be the number of pyrimidines in this segment? [1]

- (a) 34
- (b) 43
- (c) 68
- (d) 86

**Solution:** (c) 68

According to Chargaff's rule, the number of purines is always equal to the number of pyrimidines, i.e.  $A + G = T + C$ .

**Question 1.3:** Alcoholic fermentation is brought about by \_\_\_\_\_. [1]

- (a) Lactobacillus
- (b) Saccharomyces
- (c) Trichoderma
- (d) Streptomyces

**Solution:** (b) Saccharomyces

Alcoholic fermentation is mainly brought about by the Saccharomyces species.

**Question 1.4:** Which of the following is not a photosynthetic pigment? [1]

- (a) Carotene
- (b) Xanthophyll
- (c) Phycobillins
- (d) Anthocyanin

**Solution:** (d) Anthocyanin

Anthocyanin is a purple colour pigment in plants which is responsible for imparting colour to the plant part and does not play any role in photosynthesis.

**Question 1.5:** Which one of the following is a stop codon? [1]

- (a) UAG
- (b) UAC
- (c) AUG
- (d) UCA

**Solution:** (a) UAG

There are three stop or termination codons—UAA, UAG and UGA.

**Question 1.6:** Pyruvate undergoes oxidative decarboxylation to produce \_\_\_\_\_. [1]

- (a) 2-PGA
- (b)  $\alpha$ -Ketoglutarate
- (c) Succinyl-Co-A
- (d) Acetyl-Co-A

**Solution:** (d) Acetyl-CoA

Pyruvate undergoes oxidative decarboxylation to produce Acetyl-CoA in the presence of the enzyme pyruvic dehydrogenase.

**Question 1.7:** Which day is observed as 'World Environment Day'? [1]

- (a) 21st May
- (b) 5th June
- (c) 25th September
- (d) 13th December

**Solution:** (b) 5th June

5th June of every year is celebrated as World Environment Day.

**Question 2.1: Answer in 'one' sentence only [6]**

**Question 2.1.1: What is test cross? [2]**

**Solution:**

1. The cross between F<sub>1</sub> hybrid and the recessive parent is called test cross.
2. The crossing of an F<sub>1</sub> progeny with a double (homozygous) recessive parental progeny is done in order to determine whether the progeny is homozygous or heterozygous for a character under consideration. This is called as test cross.

**Question 2.1.2: What is mycoherbicide? [2]**

**Solution:** Mycoherbicides are pathogenic fungi which are used as herbicides.

**Question 2.1.3: What is Anticodon? [2]**

**Solution:** Anticodon is a triplet of nucleotides present on the anticodon arm of the t-RNA molecule which is complementary to the codon found on the mRNA molecule

**Question 2.1.4: What is Humification? [2]**

**Solution:** The process by which organic matter is converted to humus by decomposers is called humification.

**Question 2.1.5: How CO<sub>2</sub> makes idlies puffy? [2]**

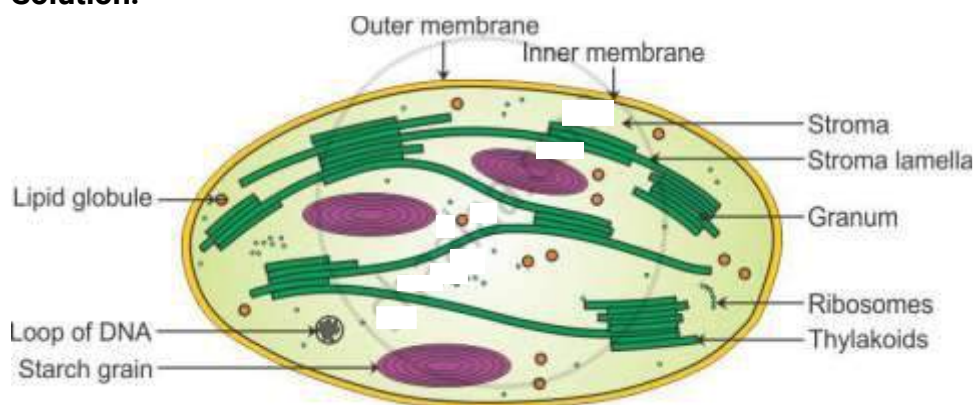
**Solution:** In the preparation of idli batter, the batter is fermented using bacteria or yeast. During fermentation, CO<sub>2</sub> bubbles which are released get trapped in the gluten, thus making idlis puffy.

**Question 2.1.6: What is ecological succession? [2]**

**Solution:** The gradual (and predictable) change in the species composition of a given area is called ecological succession.

**Question 2.2: Sketch and label the 'Ultrastructure of Chloroplast'. [2]**

**Solution:**



**Question 2.3: Answer the following (Any TWO) [4]**

**Question 2.3.1:** Write a short note on 'Mutational breeding'. [2]

**Solution:** The breeding technique in which mutations are induced using mutagens and mutant organisms with the desired characters is known as mutational breeding. In plant breeding, this technique is employed to obtain resistant varieties of plants, e.g. moong beans to yellow mosaic virus and powdery mildew.

**Question 2.3.2:** Enlist the advantages of Biogas [2]

**Solution:** Advantages of biogas:

- It is a cheap, safe and renewable source of energy.
- It burns with a blue flame and without the production of smoke.
- It can be used in homes for lighting and cooking.
- It can be used in small-scale industries and for powering street lights.
- It improves sanitation in the region.
- It is easy to produce and store and is eco-friendly and causes no pollution.

**Question 2.3.3:** Explain 'Carbon cycle'. [2]

**Solution:** Carbon cycle:

Carbon cycle is the cyclic flow of carbon in the atmosphere.

- The major processes which help in the circulation of carbon in the atmosphere and through the organisms is photosynthesis and respiration.
- Respiration requires carbohydrates and oxygen and releases carbon dioxide, water and energy. Photosynthesis requires carbon dioxide and water and produces carbohydrates and oxygen.
- The carbon trapped in organisms which is not released by respiration is released during decomposition in the atmosphere or gets converted to fossil fuels.
- The carbon trapped in fossil fuels is released during combustion.

**Question 2.3.4:** Give the floral adaptations for chiropterophily. [2]

**Solution:** Floral adaptations of chiropterophily:

- Flowers are large and stout to allow bats to hold on to them.
- They open during the night.
- They give out a rotten fruits like fermenting fruity odour.
- They produce copious nectar.
- They produce a large number of stamens.

**Question 3.1: Answer the following (Any TWO): [6]**

**Question 3.1.1:** Why the ratio in pleiotropy is 2 : 1? Explain it with example.[3]

**Solution: Pleiotropy :**

(a) When a single gene controls two (or more ) different traits, it is called pleiotropy gene and this phenomenon is called pleiotropy or pleiotropism.

The ratio is 2 : 1 instead of 3 :1.

(b) According to Mendel's principle of unit character, one gene (factor) controls one character (trait), but sometimes single gene produces two related or unrelated phenotypic expressions.

(c) For example, the disease, sickle cell anaemia is caused by a gene  $Hb^s$ . Normal or healthy gene is  $Hb^A$  and is dominant.

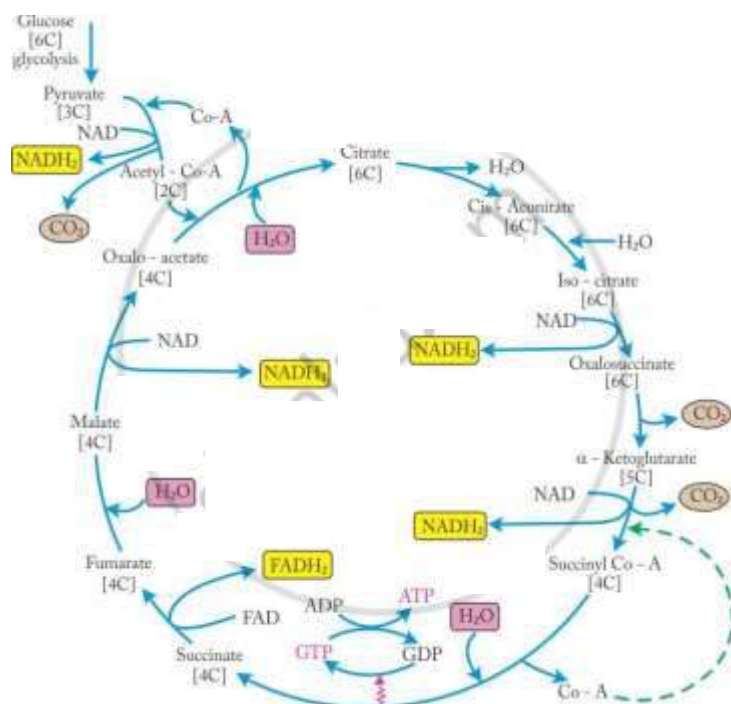
(d) The carrier (heterozygotes -  $Hb^A/Hb^s$ ) show signs of mild anaemia as their RBCs become sickle shaped (half - moon - shaped) in oxygen deficiency. They are said to have sickle-cell trait and are normal in normal conditions.

(e) The homozygotes with recessive gene  $Hb^s$  however, die of fatal anaemia.

(f) Thus the gene for sickle-cell anaemia is lethal in homozygous condition and produces sickle cell trait in heterozygous carrier.

**Question 3.1.2:** Give the schematic representation of TCA cycle. [3]

**Solution:**



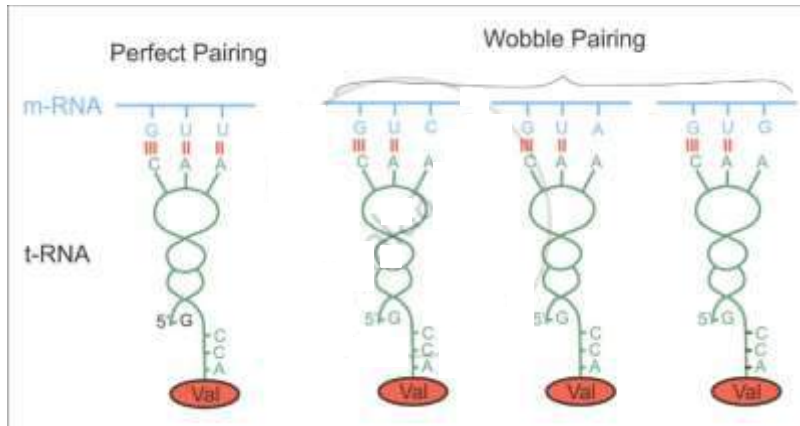
**Question 3.1.3:** Differentiate between cyclic and non-cyclic photophosphorylation. [3]

**Solution:**

Non-cyclic photophosphorylation	Cyclic photophosphorylation
1. Both photosystems I and II are involved.	1. Only photosystem I is involved.
2. The electron given out by PS-II does return back to it, but is used up by PS-I	2. The electron given out by PS-I returns back
3. It is associated with photolysis of water and liberation of oxygen.	3. It is not associated with photolysis of water, and so, oxygen is not liberated.
4. It involves ATP synthesis and production of NADPH <sub>2</sub> .	4. It involves only ATP synthesis.
5. It takes place under optimum light, aerobic conditions and the presence of CO <sub>2</sub> .	5. It takes place under low light intensity, anaerobic conditions or when CO <sub>2</sub> availability is less.
6. It is concerned with CO <sub>2</sub> fixation in all plants	6. It does not participate in photosynthesis except in some bacteria and C <sub>4</sub> plants.

**Question 3.2:** Give diagrammatic representation to show a perfect pairing and any 'two' Wobble pairings. [3]

**Solution:**



### Diagrammatic representation for perfect pairing and Wobble pairings

**Question 4: Attempt any one of following :** [7]

**Question 4.1:** What is double fertilisation? Describe the process in brief. [7]

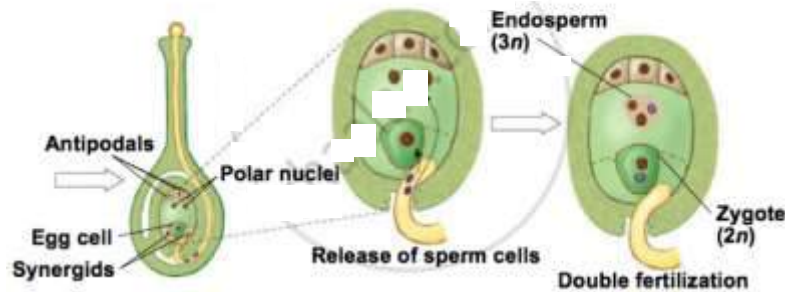
**Solution: Double fertilization** is a major characteristic of flowering plants. In this process, two male gametes fuse with one female gamete wherein one male gamete fertilizes the egg to form a zygote, whereas the other fuses with two polar nuclei to form endosperm.

Double fertilization gives stimulus to the plant that results in the development of the ovary into fruit and ovules into seed. The fusion of haploid male and female gametes restores the diploid condition of the plant.

#### Process of double fertilisation:

- After successful pollination, the pollen grain germinates on the stigma to form the pollen tube.
- The pollen tube carries in the cytoplasm two male gametes and one tube nucleus into the ovary.
- The pollen tube enters the ovary mostly through the micropyle region, near the egg apparatus. This movement is guided by the filiform apparatus.
- Inside the ovary, the pollen tube absorbs water and bursts open, releasing the two male gametes and the tube nucleus.
- The tube nucleus degenerates, and the two male gametes prepare for fusion.
- One of the male gamete fuses with the egg cell to form the diploid zygote.
- The other male gamete fuses with the diploid secondary nucleus to form the primary endosperm nucleus (PEN).
- The zygote develops to form the new plant, while the PEN develops to form the endosperm, which provides nourishment to the developing embryo.

# Double Fertilization



**Question 4.2:** Define r-DNA technology. [7]

**Solution:** Recombinant DNA (rDNA) technology is the technique of manipulating the genome of a cell or an organism to bring about a desired phenotypic change.

**Question 5:** Select and write the most appropriate answer from the given alternatives for each sub-question [7]

**Question 5.1:** If centromere is situated in the middle of the chromosome, it is called \_\_\_\_\_. [1]

- (a) Metacentric
- (b) Acrocentric
- (c) Submetacentric
- (d) Telocentric

**Solution:** (a) Metacentric

Type of chromosome	Position of centromere
Metacentric	Middle of the chromosome
Acrocentric	End of the chromosome
Submetacentric	Some distance away from the middle of the chromosome
Telocentric	Tip of the chromosome

**Question 5.2:** Which one of the following is useful in treatment of burns and wound healing? [1]

- (a) Tissue plasminogen activator
- (b) Tissue growth factor
- (c) DNase
- (d) Bovine growth hormone

**Solution:** (b) Tissue Growth Factor



Therapeutic product	Use
Tissue plasminogen activator	Prevents or reverses blood clots
Tissue growth factor	Treatment of burns and wound healing
DNAse	Treatment of cystic fibrosis
Bovine growth hormone	Increases cattle and dairy yields

**Question 5.3:** Erythroblastosis foetalis is caused when mother is \_\_\_\_\_. [1]

- (a) Rh+ve
- (b) With antibody 'A'
- (c) Rh-ve
- (d) With antibody 'B'

**Solution:** (b) Tissue Growth Factor

Therapeutic product	Use
Tissue plasminogen activator	Prevents or reverses blood clots
Tissue growth factor	Treatment of burns and wound healing
DNA se	Treatment of cystic fibrosis
Bovine growth hormone	Increases cattle and dairy yields

**Question 5.4:** Deposition of fatty substances in the lining of arteries results in \_\_\_\_\_. [1]

- (a)Arteriosclerosis
- (b)Atherosclerosis
- (c)Hyperglycemia
- (d)Hypotension

**Solution:** (b) Atherosclerosis

Atherosclerosis refers to the deposition of fatty substances in the lining of the arteries. This results in the formation of an atherosclerotic plaque which decreases the size of the arterial lumen.

**Question 5.5:** Struggle between cow and cow for getting grass is called \_\_\_\_\_. [1]

- (a) Inter-specific struggle

- (b) Environmental struggle
- (c) Struggle against natural calamities
- (d) Intra-specific struggle

**Solution:** (d) Intraspecific struggle

Intraspecific struggle occurs when the members of the same species fight for the same resources in an ecosystem. Interspecific struggle occurs when the members of two separate species share the same resources in the same area.

**Question 5.6:** In which type of adaptation, forelimbs are modified into wings? [1]

- (a) Aquatic adaptations
- (b) Volant adaptations
- (c) Arboreal adaptations
- (d) Cursorial adaptations

**Solution:** (b) Volant adaptation

Aerial or volant adaptation is an adaptation for flying. In birds, the forelimbs are modified into wings.

**Question 5.7:** Mating of two closely related individuals within the same breed is called \_\_\_\_\_. [1]

- (a) In-breeding
- (b) Out-breeding
- (c) Out-crossing
- (d) Cross-breeding

**Solution:** (a) In-breeding

Breeding technique	
In-breeding	Mating of two closely related individuals within the same breed
Out-breeding	Mating of two unrelated individuals of the same breed or different breeds
Out-crossing	Mating of two unrelated individuals of the same breed but having no common ancestor
Cross-breeding	Mating of superior male of one breed with superior female of another breed

**Question 6.1: Answer the following in 'one' sentence each:** [6]

**Question 6.1.1:** Visit of a veterinary doctor to dairy farm is mandatory. Give reasons. [1]

**Solution:** Visit of a veterinary doctor to a dairy farm is mandatory for the identification of health problems and diseases and their rectification.

**Question 6.1.2:** Why aquatic animals can afford to be ammonotelic? [1]

**Solution:** Ammonotelic animals require a large quantity of water for the elimination of ammonia. Because aquatic animals stay in water, they can afford to be ammonotelic and excrete their wastes in the form of ammonia.

**Question 6.1.3:** Why PUC is mandatory for vehicles? [1]

**Solution:** Pollution Under Control (PUC) certificate is mandatory for all vehicles to check air pollution.

**Question 6.1.4:** Define organic evolution. [1]

**Solution:** Define organic evolution.

Organic evolution is a slow, gradual, continuous and irreversible change through which the present-day complex forms have descended from their simple pre-existing forms of the past.

**Question 6.1.5:** Give the genotype of Turner's syndrome. [1]

**Solution:**

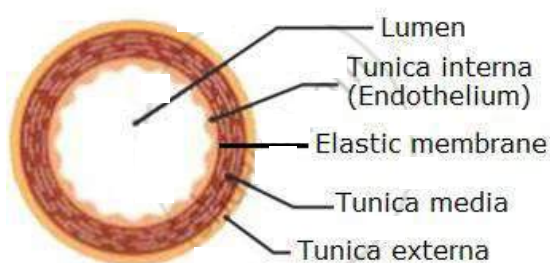
The genotype of Turner's syndrome is represented by (44 + XO).

**Question 6.1.6:** Write down the full form of R.F.L.P. [1]

**Solution:** RFLP stands for Restriction Fragment Length Polymorphism.

**Question 6.2:** Sketch and label T.S. of vein [1]

**Solution:**



**Question 6.3: Attempt any TWO of the following:** [4]

**Question 6.3.1:** Give any 'two' factors responsible for genetic variation. [2]

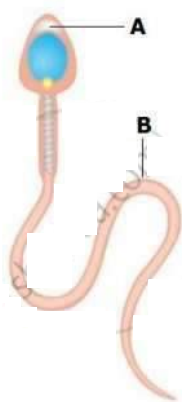
**Solution:** Gene mutations, gene flow, genetic recombination, genetic drift and chromosomal aberration are some factors responsible for genetic variation.

- Gene mutations: These involve changes in the chemical constitution of a gene. They introduce variations in the gene pool and are responsible for the change in the gene

frequency.

- Genetic recombination: Organisms reproducing sexually undergo gametogenesis during which the homologous chromosomes exchange genetic material by the process of crossing over. This produces new combinations of genes resulting in genetic variation.

**Question 6.3.2:** Give the name and function for 'A' and 'B' from the diagram given below [2]



**Solution:**

	Name	Function
A	Acrosome	Secretes hydrolytic enzymes such as hyaluronidase which helps the sperm to penetrate the egg during fertilisation
B	Tail	Flagellar movements enable the sperm to ascend in the female reproductive tract

**Question 6.3.3:** Write a note on 'artificial acquired active immunity'. [2]

**Solution:** Artificially acquired active immunity:

- It is acquired artificially by vaccination.
- Vaccines contain dead or live but attenuated pathogens or toxoids.
- These consist of microbial components or toxins secreted by the pathogens.
- The vaccine is introduced into the body to stimulate the production of antibodies by the immune system.
- Examples: Polio vaccine, BCG vaccine

**Question 6.3.4:** Give the economic importance of 'fisheries' [2]

**Solution:** Artificially acquired active immunity:

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- Examples: Polio vaccine, BCG vaccine

**Question 7: Attempt any TWO of the following:** [6]

**Question 7.1.1:** Explain sex determination in human beings. [3]

**Solution 1: Sex determination in human beings:-**

- In human beings, the chromosomal mechanism of sex determination is of the XX-XY type.
- In humans, the nucleus of each cell contains 46 chromosomes or 23 pairs of chromosomes. Of these, 22 pairs are of autosomes and 1 pair is of sex chromosomes.
- Females possess two homomorphic sex chromosomes, XX.
- Males contain two heteromorphic sex chromosomes, XY.
- Females are homogametic and produce only one type of egg, (22+X).
- Males are heterogametic and produce two types of sperms, (22+X) and (22+Y).
- During fertilisation, if the sperm containing X chromosome fertilises the egg having X chromosome, then the resulting offspring would be a female (XX).
- If the sperm containing Y chromosome fertilises the egg having X chromosome, then the resulting offspring would be a male (XY).
- The sex ratio produced in the progeny is 1:1.
- This chromosomal mechanism of sex determination is called heterogametes. It may be male heterogametes or female heterogametes.

**Solution 2: Sex Determination in human being:**

a. Human diploid cell has 46 chromosomes, i.e. 23 pairs in each cell.

Out of these, 22 pairs of chromosomes are called autosomes and one pair of chromosome is called sex chromosomes.

They are X and Y chromosomes.

b. Every individual gets one set of chromosomes from his mother and one from his father.

A human male thus has 44 + XY chromosomes, whereas a female has 44 + XX chromosomes.

c. During gamete formation; meiosis or reductional division takes place and a gamete gets only one set of chromosomes and thus it is haploid.

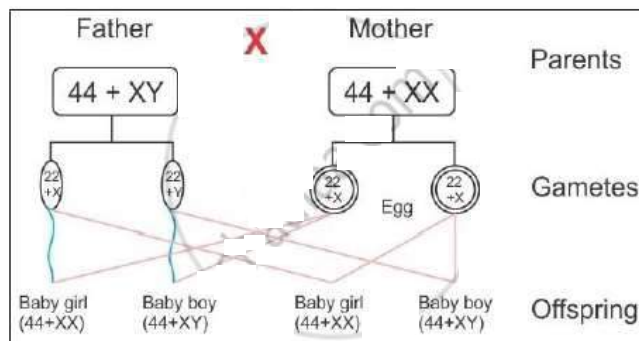
e.g. Female gamete (ovum) 22 + X, Male gamete (sperm) 22 + X or 22 + Y.

When the male and female gametes unite to form a zygote, the chromosomes again become diploid.

d. Thus, the offspring gets the same number of chromosomes as his parents. Sex of the baby is determined by the nature of sperm (X or Y) that fertilizes the ovum. Thus, in human being, it is the male which determines the sex of the baby.

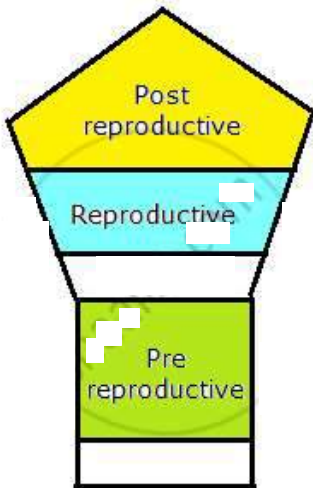
**Solution 3:** Determination of sex in human beings:

- In human beings, the male possess 44 autosomes and a pair of heteromorphic sex chromosomes, XY, while the female possess 44 autosomes and a pair of homomorphic sex chromosomes, XX.
- At the time of gamete formation, meiosis occurs.
- The male parent produces X-bearing and Y-bearing gametes or sperms. The female parent produces only X-bearing gametes or eggs.
- During reproduction, the combination of one X-bearing gamete from the male with one X-bearing gamete from the female results in offspring with the genetic constitution XX. The child produced is a female or a daughter.
- The combination of a Y chromosome from the male with one X chromosome from the female results in an offspring with genetic constitution XY. The child produced is a male or a son.
- The offspring produced are always in equal proportion, and hence, the chance of having a daughter or a son is 50%.



**Question 7.1.2:** Describe steady population with the help of a pyramid. [3]

When the pre-reproductive and the post-reproductive age groups in a population have almost the same number of individuals, then the population remains stable. This kind of population is called steady population. The young individuals in the age group of 0–14 years are proportional to the old individuals in the age group of 60 years and above.



**Steady population**

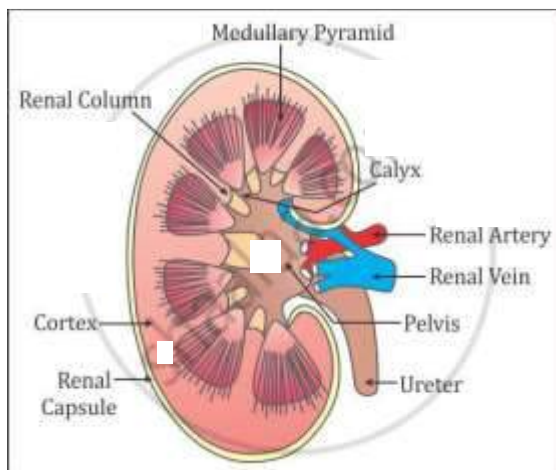
**Question 7.1.3:** Illustrate any 'three' genes which can be used in gene therapy. [3]

**Solution:** Some examples of genes which can be used in gene therapy:

- 1) Tissue growth factor-beta (TGF- $\beta$ ): It promotes new blood vessels and epidermal growth. It is useful in wound healing and treatment of burns.
- 2) Tissue plasminogen activator (TPA): It is used to prevent or reverse blood clots.
- 3) Human blood clotting factor VIII: It is used to aid in the clotting of blood and to treat patients suffering from haemophilia.

**Question 7.2:** Sketch and label 'L.S. of human kidney' [3]

**Solution:**



**Question 8.1:** With the help of diagrammatic representation, explain the process of gametogenesis [7]

**Solution: Gametogenesis:-**

The process of formation of gametes in sexually reproducing animals is called gametogenesis.

The germinal cells form the gametes by mitosis and meiosis.

The process of formation of male gamete or spermatozoa is called spermatogenesis.

The process of formation of female gamete or ovum is called oogenesis.

### **Spermatogenesis:-**

The process of spermatogenesis occurs in the seminiferous tubules of the testes of males.

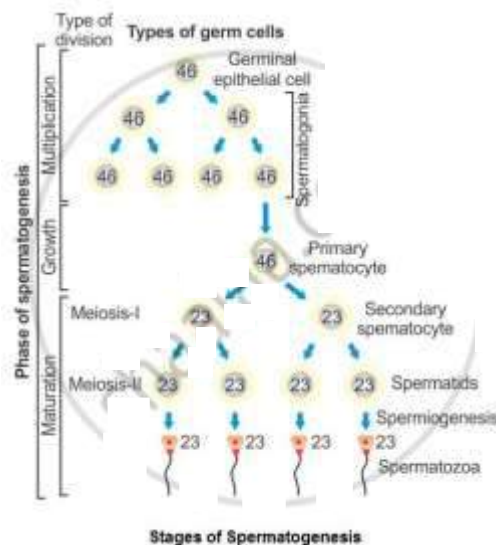
Spermatogenesis includes the formation of spermatids and spermatozoa.

It involves the following phases:-

**Multiplication phase:** The undifferentiated primordial germ cells divide several times by mitosis to produce a large number of spermatogonia ( $2n$ ).

**Growth phase:** Each type B spermatogonia actively grows to form a larger primary spermatocyte by obtaining nourishment from nursing cells.

**Maturation phase:-** Each primary spermatocyte undergoes two successive divisions called maturation divisions. The first division is reductional or meiotic division where each primary spermatocyte divides into two haploid daughter cells called secondary spermatocytes. Both secondary spermatocytes undergo a second maturation division to form four haploid spermatids from a single primary spermatocyte.



### **Oogenesis:-**

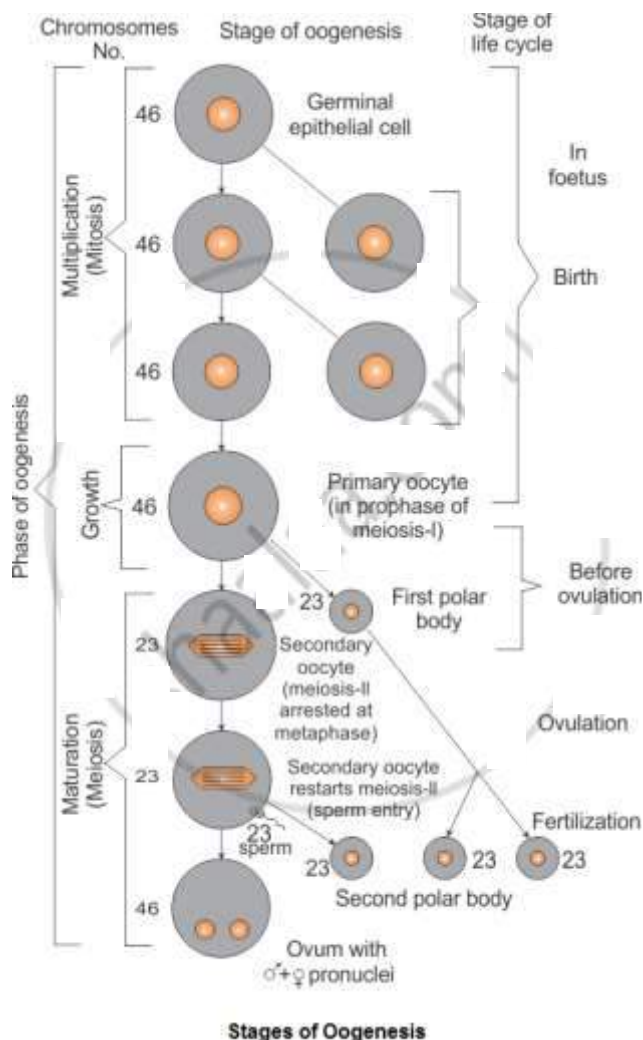
The process of oogenesis occurs in the ovaries of females.



**Multiplication phase:** During foetal development, certain cells of the germinal epithelium divide by mitosis and form undifferentiated germ cells called oogonia or egg mother cells ( $2n$ ).

**Growth phase:** The oogonium grows into large primary oocytes.

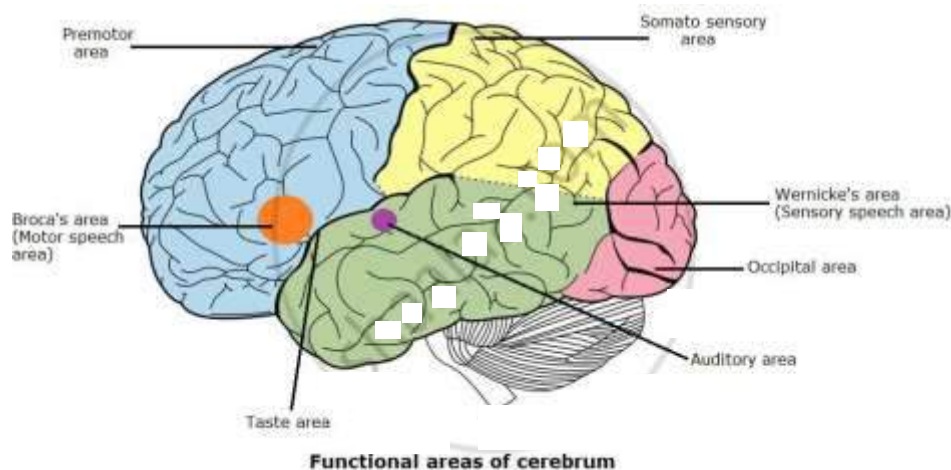
**Maturation phase:** Each primary oocyte undergoes two maturation meiotic divisions. In the first meiotic division, the primary oocyte divides into two very unequal haploid daughter cells—a large secondary oocyte and a small first polar body or polocyte. In the second maturation division, the first polar body may divide to form two second polar bodies. The secondary oocyte again divides into unequal daughter cells—a large ootid and a very small second polar body. The ootid grows into a functional haploid ovum. One oogonium gives rise to one ovum and three polar bodies.



**Question 8.2:** Describe the structure of cerebrum. Add a note on its function. [7]

**Solution: Structure of the cerebrum:-**

- It is the largest portion of the brain and constitutes about 80–85% of the weight of the brain.
- It is divided into two cerebral hemispheres by a median longitudinal fissure.
- The cerebral hemispheres are connected to each other by a thick band of transverse nerve fibres called corpus callosum.
- A cavity filled with cerebrospinal fluid (CSF) is present in each hemisphere. It is called the lateral ventricle.
- The outer surface of the cerebral hemisphere is called the cerebral cortex.
- The cortex contains cell bodies of the neuron and is greyish; hence, it is called grey matter.
- The grey matter has many folds (i.e. gyri) and grooves (i.e. sulci). They increase the surface area to accommodate more nerve cells.
- A higher number of convolutions lead to greater intelligence.
- The inner surface of the cerebral hemisphere is called the cerebral medulla.
- The medulla consists of axons of nerve fibres and is called white matter.
- Each cerebral hemisphere is divided into four lobes—frontal lobe, parietal lobe, occipital lobe and temporal lobe.
- The frontal and occipital lobes are separated by a central sulcus; the parietal and temporal lobes are separated by a lateral sulcus, while the parietal and occipital lobes are separated by a parieto-occipital sulcus.



**Functions of the cerebrum:-**

- The cerebrum determines intelligence in animals.
- It is also the centre of learning and memorising in the brain.

**Functional areas of the cerebrum:-**

- Frontal lobe:- It consists of the motor area which controls voluntary activities. Broca's area is the motor speech area which translates thoughts into speech and controls the movements of the tongue, lips and vocal cords. The association area related to intelligence, memory, judgement and problemsolving ability is found in the frontal lobe.
- Parietal lobe:- The general sensory area associated with the sensation of temperature, touch, pressure, pain and speech is located on the post-central gyrus of the parietal lobe.
- Temporal lobe:- The areas concerned with the sense of taste, sense of hearing and sense of smell are located on the temporal lobe.
- Occipital lobe:- It carries the sensory visual area concerned with the sense of vision and the association visual area for perception, analysis and storage of information obtained by sight.