

Maharashtra State Board
Class XII Biology
Board Paper – 2016 Solution

SECTION-I
[BOTANY]

Q. 1.

- (i) (b) 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_2 generation is 1:2:1.

- (ii) (c) 68

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

- (iii) (b) *Saccharomyces*

Alcoholic fermentation is mainly brought about by the *Saccharomyces* species.

- (iv) (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.

- (v) (a) UAG

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

- (vi) (d) Acetyl-CoA

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

- (vii) (b) 5th June

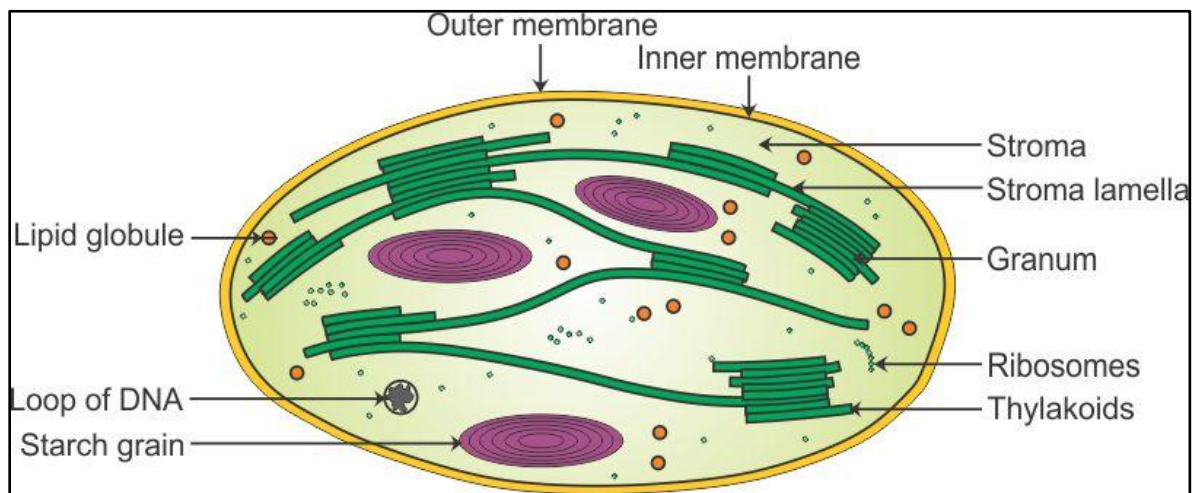
5th June of every year is celebrated as World Environment Day.

Q. 2.

(A)

- (i) A test cross is a simple method which was devised by Mendel to determine the genotype of the F_1 hybrids.
- (ii) Mycoherbicides are pathogenic fungi which are used as herbicides.
- (iii) 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.
- (iv) The process by which organic matter is converted to humus by decomposers is called humification.
- (v) In the preparation of idli batter, the batter is fermented using bacteria or yeast. During fermentation, CO_2 bubbles which are released get trapped in the gluten, thus making idlis puffy.
- (vi) The sequential change in the composition and structure of the community until the climax community is reached is known as ecological succession.

(B)



Ultrastructure of Chloroplast

(C)

- (i) 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.

(ii) **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.

(iii) **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.

(iv) **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.

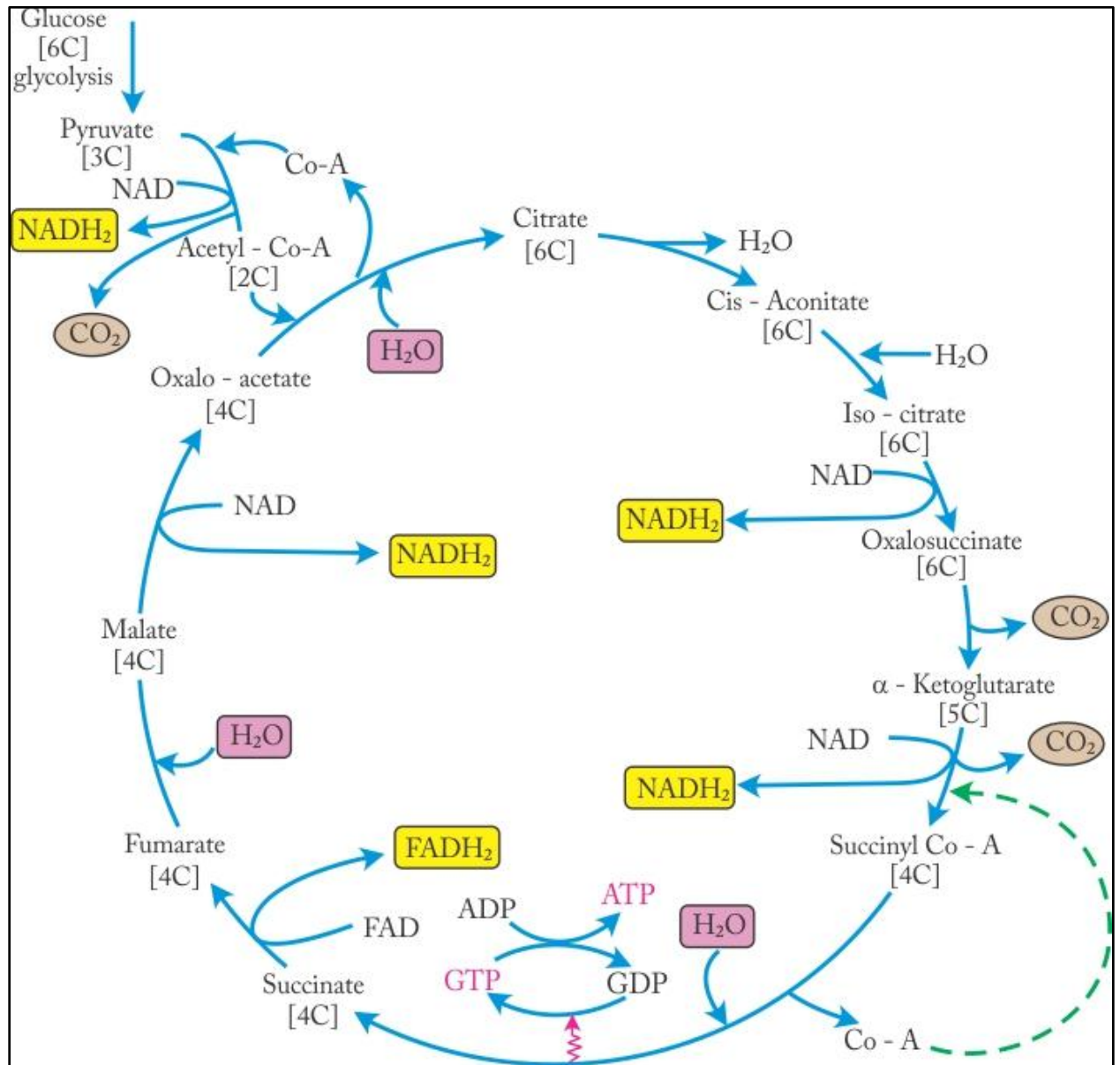
Q. 3.

(A)

(i)

- Pleiotropic gene is a gene which controls or produces two or more traits or expressions, respectively, and the phenomenon is known as pleiotropy.
- For example, the disease sickle cell anaemia is caused by this phenomenon. The disease is caused by gene Hb^S .
- In a normal or healthy individual, the gene is Hb^A , which is dominant.
- A heterozygote is a carrier and shows mild signs of anaemia, and the RBCs become sickle-shaped with a deficiency of oxygen.
- The homozygous recessive individuals however show fatal anaemia and die.
- Hence, if two carriers for sickle cell anaemia mate, the children are formed in the ratio of 1:2:1, with 1 normal, 2 carriers and 1 diseased.
- Because the diseased child dies, the observed ratio of the surviving children is 1:2.
- Thus, pleiotropy shows a 2:1 ratio and not the normal Mendelian 3:1 ratio.

(ii)

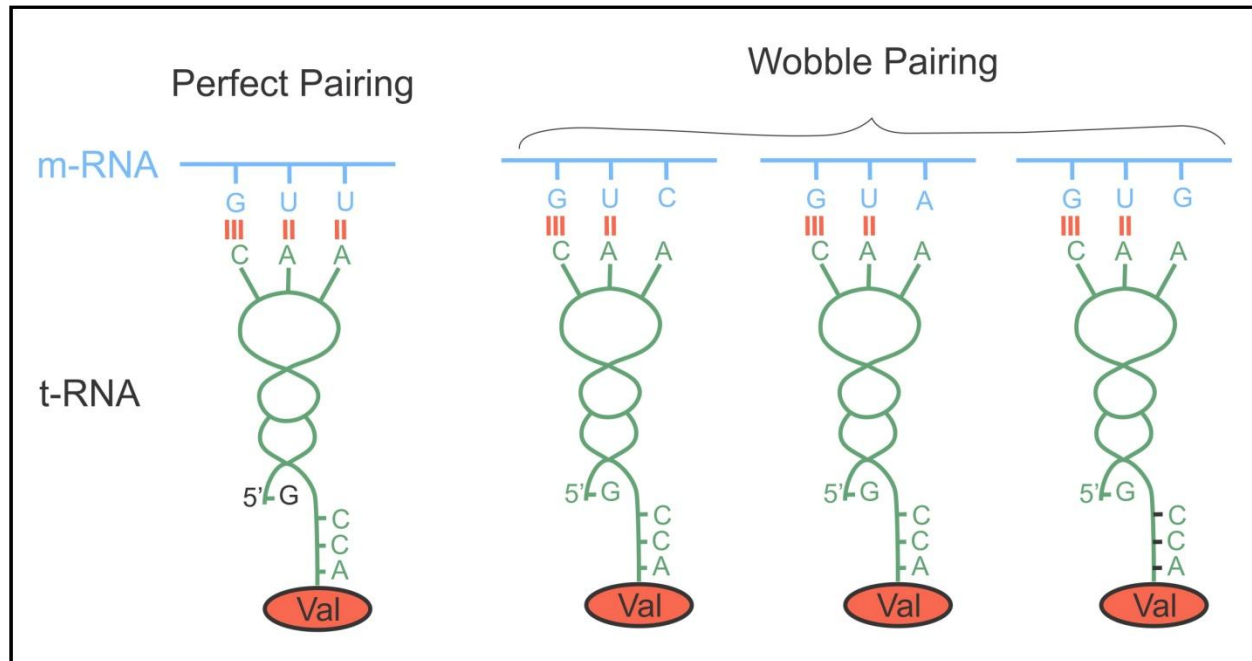


Schematic representation of the TCA cycle

(iii) **Differences between cyclic and non-cyclic photophosphorylation:**

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.	4. It involves only ATP synthesis.
5. It takes place under optimum light, aerobic conditions and the presence of CO ₂ .	5. It takes place under low light intensity, anaerobic conditions or when CO ₂ availability is less.
6. It is concerned with CO ₂ fixation in all plants.	6. It does not participate in photosynthesis except in some bacteria and C ₄ plants.

(B)



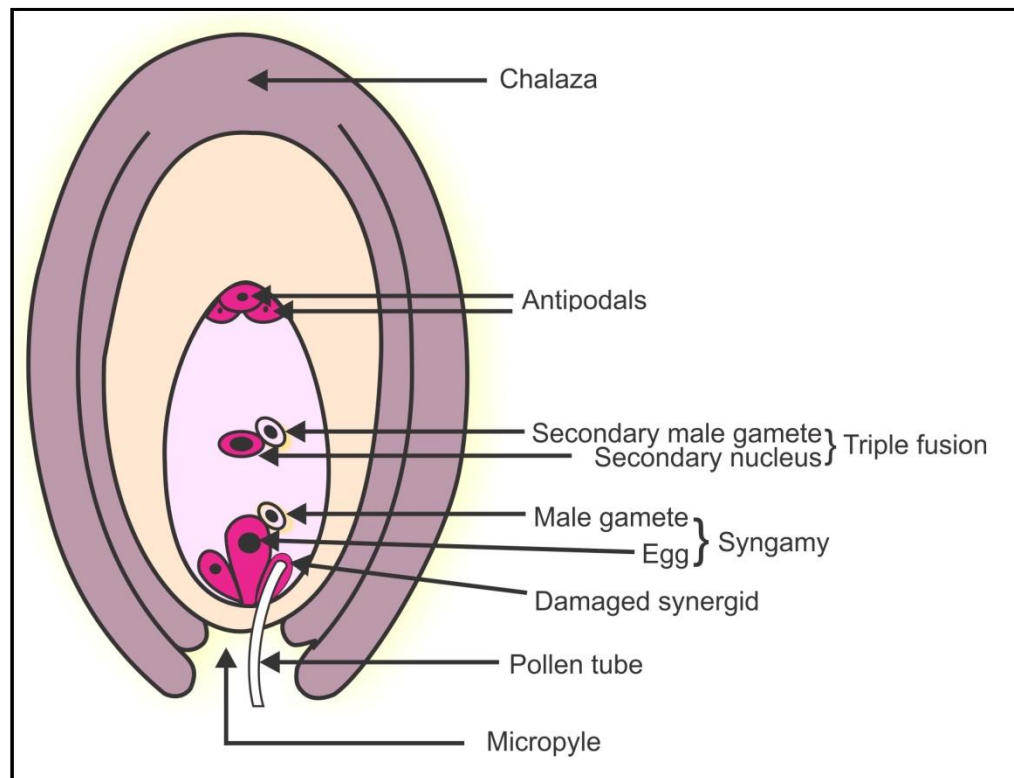
Diagrammatic representation for perfect pairing and Wobble pairings

Q. 4.

The type of fertilisation in plants in which one male gamete fuses with the egg to form the embryo and the other male gamete fuses with the secondary nucleus to form the primary endosperm nucleus is known as double fertilisation.

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.



Double fertilisation

- 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.

OR

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

Steps involved in rDNA technology:

- Identifying the donor cell and isolating its DNA
- Fragmenting the DNA using 'molecular scissors' (restriction enzymes)
- Screening the fragmented DNA for the desired gene
- Inserting the desired DNA fragment into a cloning vector to produce the recombinant DNA
- Introducing the recombinant vector organism in the desired host cell
- Culturing the recombinant cells to obtain multiple copies of the desired DNA fragment
- These DNA fragments are then used to transform desired host cells where the expression of the gene is desired

Therapeutic products obtained by rDNA technology:

- Blood proteins, such as erythropoietin, Factor VII, VIII and IX, tissue plasminogen activator, urokinase
- Human hormones, including epidermal growth factor, follicle-stimulating hormone, insulin, nerve growth factor, relaxin, somatotropin
- Immune modulators, such as α -interferon, β -interferon, colony stimulating factor, lysozyme, tumour necrosis factor
- Vaccines, such as cytomegalovirus vaccine, hepatitis B vaccine, measles vaccine, rabies vaccine

SECTION II
[ZOOLOGY]

Q. 5.

(i) (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

(ii) (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

(iii) (c) Rh^{-ve}

Erythroblastosis foetalis occurs when an Rh^{-ve} woman carries an Rh^{+ve} foetus. The immune system of the mother produces antibodies against the red blood cells of the infant, resulting in the destruction of the red blood cells of the foetus.

(iv) (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.

(v) (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.

(vi) (b) Volant adaptation

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

(vii) (a) In-breeding

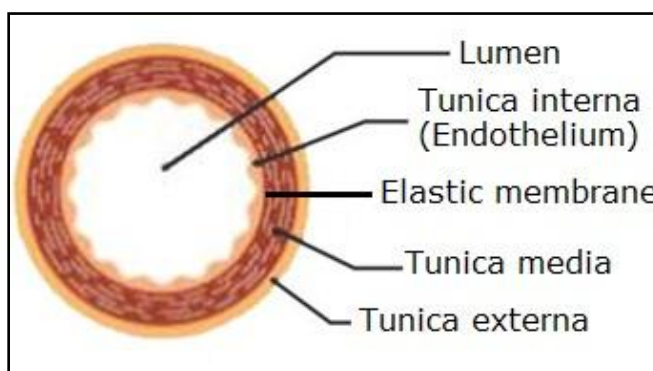
Breeding technique	Description
In-breeding	Mating of two closely related individuals within the same breed
Out-breeding	Mating of two unrelated individuals of the same breed or different breeds
Out-crossing	Mating of two unrelated individuals of the same breed but having no common ancestor
Cross-breeding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

Q. 6.

(A)

- (i) Visit of a veterinary doctor to a dairy farm is mandatory for the identification of health problems and diseases and their rectification.
- (ii) 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.
- (iii) Pollution Under Control (PUC) certificate is mandatory for all vehicles to check air pollution.
- (iv) 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.
- (v) The genotype of Turner's syndrome is represented by (44 + XO).
- (vi) RFLP stands for Restriction Fragment Length Polymorphism.

(B) T.S. of vein:



(C)

(i) 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.

(ii)

	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

(iii) **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

(iv) **Economic importance of fisheries:**

- Act as a source of nutritious food
- Yield several by-products which are of commercial value
- Provide good job opportunities and self-employment to many people
- Help to boost the productivity and economy of the nation

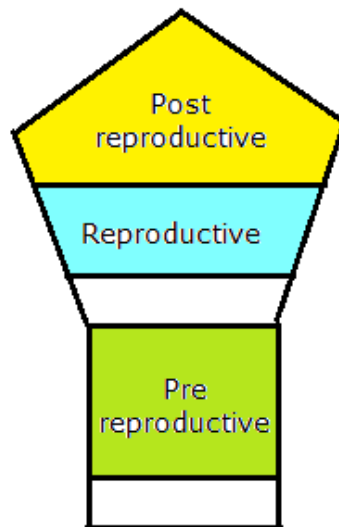
Q. 7.

(A)

(i) 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 heterogamety or female heterogamety.

- (ii) 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.

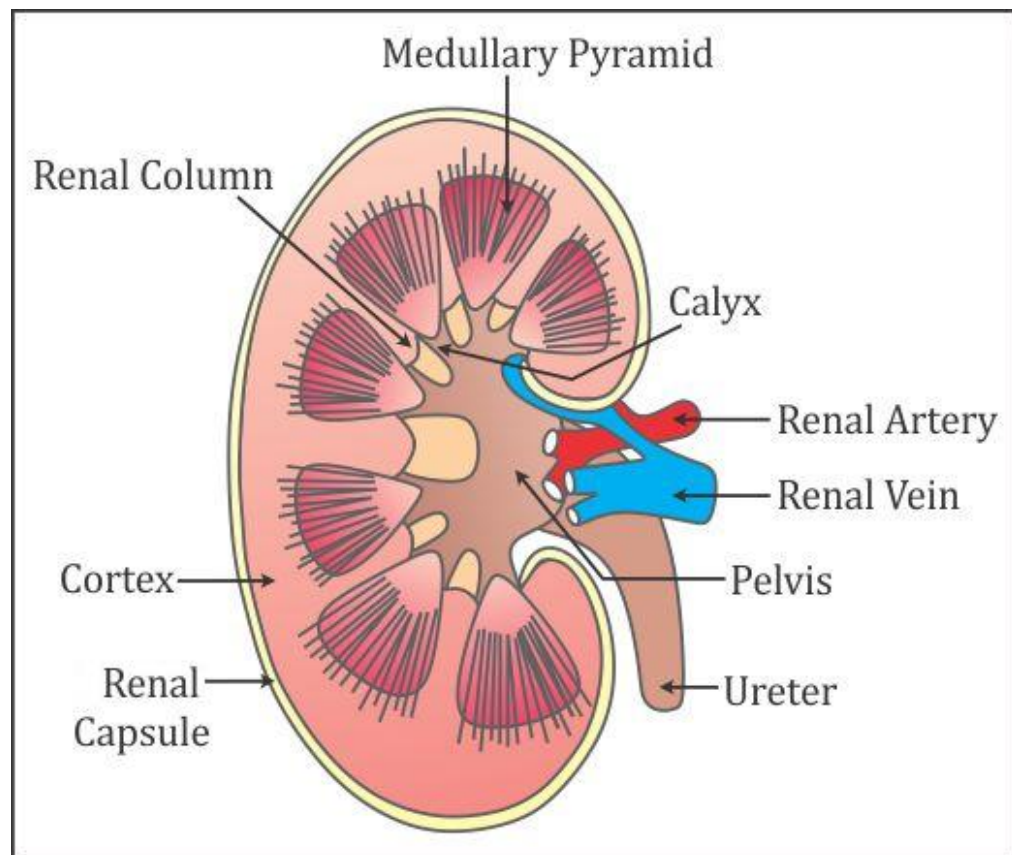


Steady population

(iii) Some examples of genes which can be used in gene therapy:

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

(B) L.S. of human kidney:



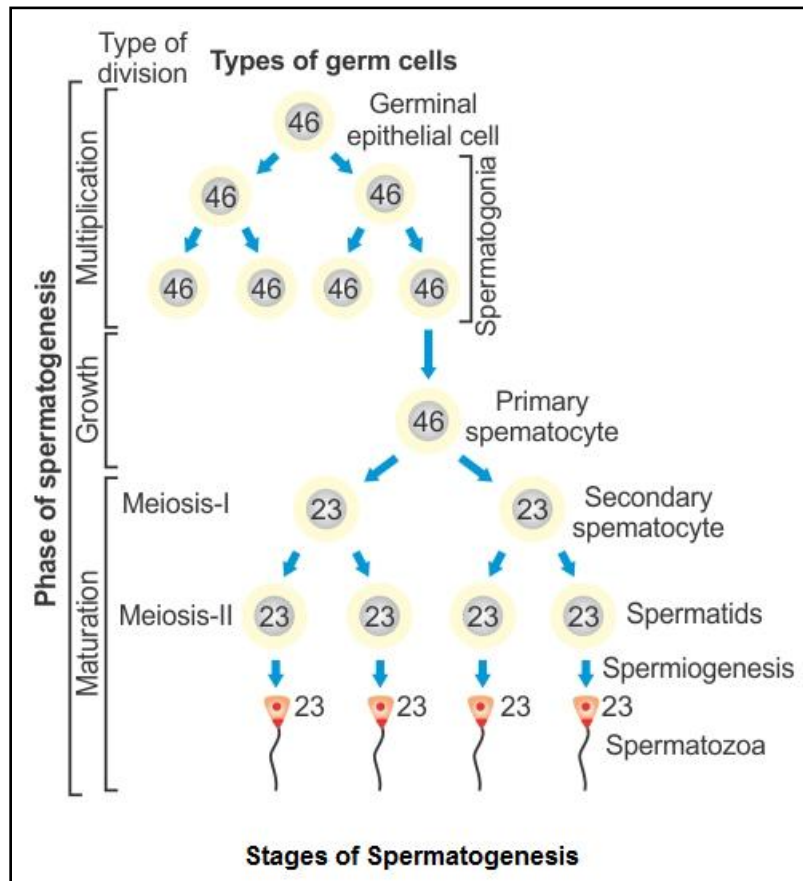
Q. 8.

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.

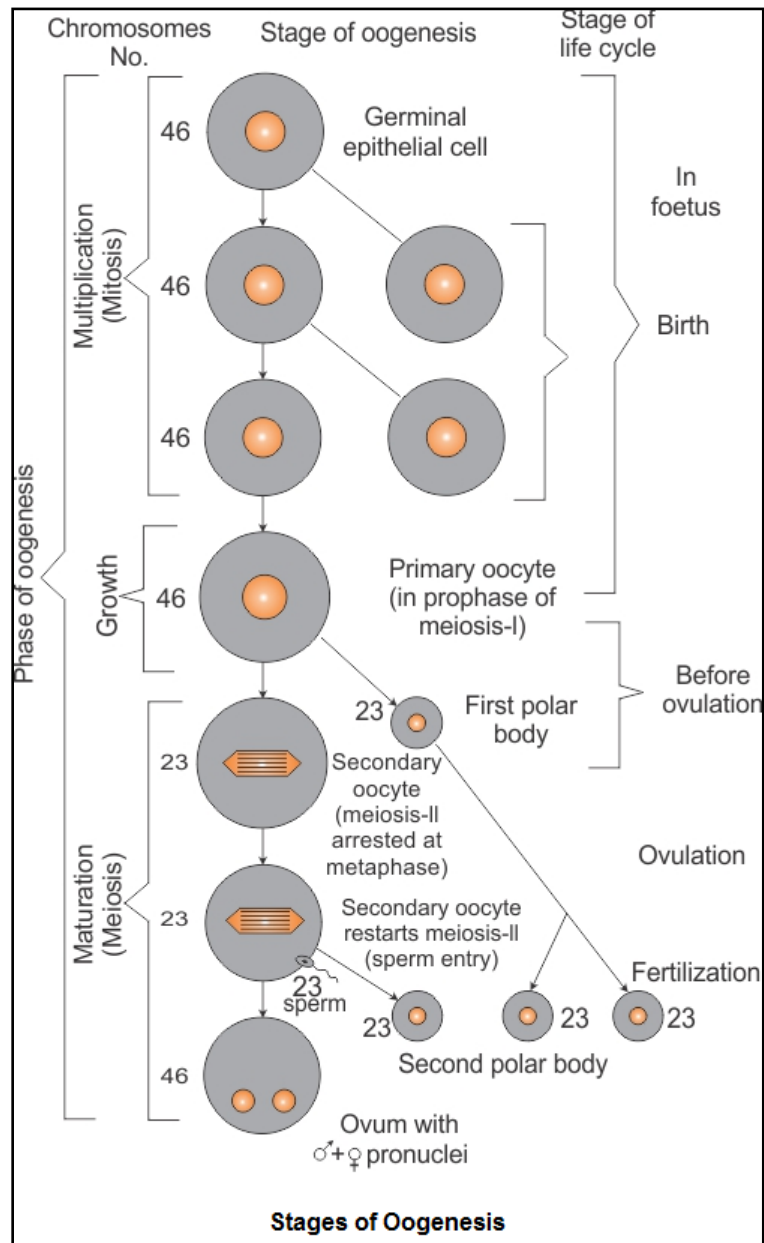
Spermatogenesis:

- 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:

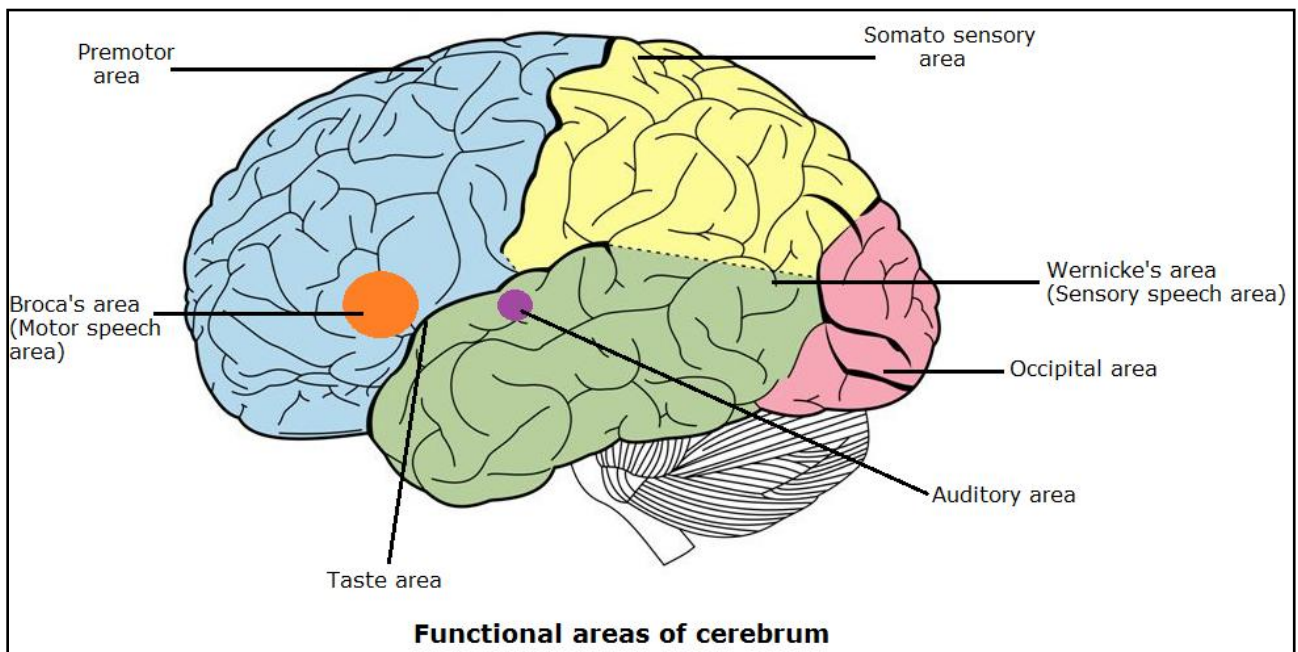
- The process of oogenesis occurs in the ovaries of females.
- Multiplication phase: During foetal development, certain cells of the germinal epithelium divide by mitosis and form undifferentiated germ cells called oogonia or egg mother cells ($2n$).
- Growth phase: The oogonium grows into large primary 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.



OR

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 problem-solving 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.