

CBSE
Class XII Biology
Sample Paper 4 (Solution)

Time: 3 hrs

Total Marks: 70

Section A

1. It provides protein to the embryo for germination.
2. They are a rich source of genes for resistance to various stress conditions in plants grown in that area.
3. The Ti plasmid of Agrobacterium has T-DNA which has an innate ability to transform its host plant cells.
4. It is a technique by which holes are created in the plasma membrane of a host cell to facilitate the entry of foreign DNA.
5. The secondary immune response is more intense than the primary immune response in humans because the memory B cells deal with the invading microbes by producing antibodies. The cells of the body remember that they have previously encountered this type of infection.

Section B

6. The seminiferous tubules in the testes are in the form of loops, in which both ends continue in short segments of straight tubules, the tubuli recti. These tubules connect the seminiferous tubules to a highly anatomising labyrinth of cuboidal epithelium-lined channels, the rete testis.
7. Test cross: It is a cross between an individual of an unknown genotype and an individual which is homozygous for recessive characters.
A test cross is done to confirm the purity of the F_1 hybrid whether it is homozygous or heterozygous.

OR

- (a) 4; because the linkage group equals the number of haploid chromosomes.
(b) The two characters being located on two different chromosomes will be unlinked and hence will follow Mendelian inheritance and the law of independent assortment.
8. The full name of the disease is Acquired Immunodeficiency Syndrome (AIDS).
This disease is transmitted by contaminated needles and blood transfusion.
9. It is the start point where DNA replication begins at a specific point where intertwined DNA segments start unwinding. There is a single origin of replication in prokaryotic cells, whereas there are numerous origins of replication in eukaryotic cells.
10. Transgenic Plant: Flavr Savr Tomato
Transgenic Animal: Super mouse
11. Reproductive isolation is the inability of interbreeding of even related groups of animals due to presence of some isolating mechanism. Its significance is that it helps in evolutionary divergence.
12. Ex situ is a desirable approach to protect the wild cat. The organism is protected outside their natural habitat where special care is taken to protect them.
By using cryopreservation techniques, gametes of threatened species can be preserved under very low temperature.

Section C

- 13.** In sexually reproducing organisms, the process of meiosis occurs during gametogenesis to reduce the number of chromosomes to half in male and female gametes. During fertilisation, the fusion of male and female gametes takes place to form the diploid zygote. The diploid zygote grows into an adult organism and reproduces sexually.

If there is no meiosis in the reproductive cells during gametogenesis, then the chromosomes will double at each fertilisation and an abnormal organism will be formed. Thus, meiosis and gametogenesis are always linked to avoid the multiplication of species and to restore the original diploid chromosome number.

- 14.** Ovulation is the process where matured ovum at the secondary oocyte stage is released from the ovary by the rupturing of its Graafian follicles. The ovum is released in the abdominal cavity. It is picked up by fimbriae and conveyed to the fallopian tube. After ovulation, the Graafian follicle is transformed into the corpus luteum and regenerates. The progesterone secretion stops and results in the start of a fresh menstrual cycle.

In human beings, the ovulation process occurs between the menstrual period (after the 14th day of the start of the menstrual cycle) under the combination of FSH and luteinising hormone (LH; or interstitial cell-stimulating hormone, ICSH). The ovulation process lasts for about 6 hours, and during this period, body temperature increases, and it remains high during the rest of the period.

OR

- (a) The copper-releasing IUDs are Multiload 375 and CuT.
(b) IUDs increase phagocytosis of sperms in the uterus and copper ions released suppress sperm motility and their ability to fertilise the ovum.

- 15.** According to the given condition, brown eye colour is dominant over blue eye colour.

Father × Mother (blue-eyed)



Man (brown eyed)

- (a) The mother genotype must be bb as she is recessive for blue-coloured eye. The man is brown-eyed (dominant character). It is possible that the genotype is Bb as he is procuring one of the recessive genes from his mother.
(b) As the genotype of the man is Bb, so the possible genotypes of his father are BB or Bb.

(c) Parents ... Brown-eyed man (heterozygous) × Blue-eyed woman
 Genes ... Bb × bb
 Gametes ... B, b × b, b

b	Bb Brown-eyed	bb Blue-eyes
b	Bb Brown-eyed	bb Blue-eyed

Result: 50% offspring with brown eye having genotype Bb. 50% offspring with blue eye having genotype bb.

16.

- Genes on the same chromosomes were closely associated and are called linked genes. He discovered the process of linkage. The genes could be far apart.
- When genes are linked, the percentage of parental combination is higher than recombinants.
- When genes are neither linked nor loosely linked or far apart, the percentage of the parental combination is less than the recombinants.

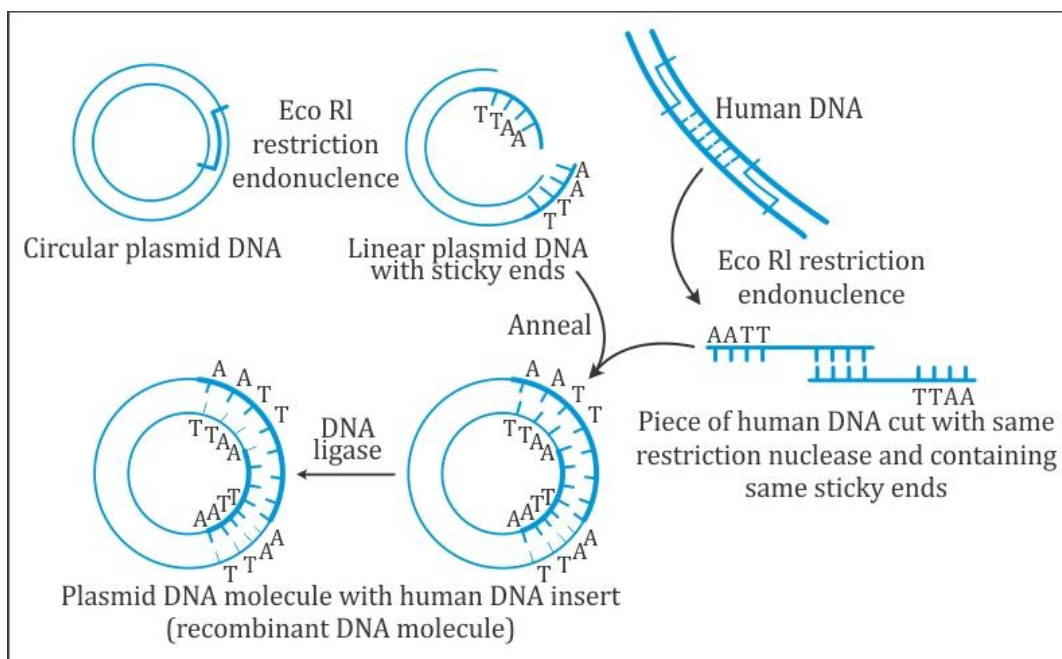
17. Integrated pest management (IPM) aims at the minimum use of pesticides to prevent agrochemical pollution and to adopt natural methods of pest control as far as possible. Natural methods of pest control are part of a larger agricultural strategy and include:

- Use of crop varieties resistant to local pests
- To carry the practice of crop rotation and improved sanitation
- To adopt the biological control method and starvation method
- To grow planting or preferred target crop to lure away insects

18. Plasmodium enters the human body through the bite of the female Anopheles mosquito. The parasite initially multiplies within the liver cells and then attacks the RBCs, resulting in their rupture. The rupture of RBCs results in the release of a toxic substance, haemozoin, which is responsible for the chill and high fever for 3–4 days. When a female Anopheles mosquito bites an infected person, these parasites enter the mosquito's body and multiply within to form sporozoites which are stored in the salivary glands. When these mosquitoes bite humans, the sporozoites are introduced into the body.

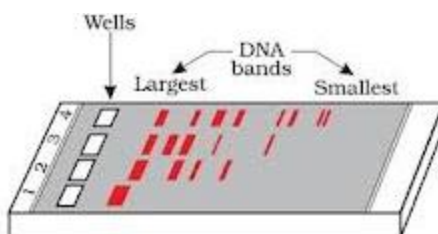
Thus, Plasmodium (malarial parasite) requires two hosts—man and mosquito—to complete its life cycle. The female Anopheles mosquito acts as the vector.

19.



20. Gel electrophoresis is a technique of separating DNA fragments formed by the action of restriction endonucleases.

The fragments of DNA are placed in a typical agarose gel under an electric field. The DNA fragments move towards the anode as these fragments are negatively charged molecules. The DNA fragments separate according to their size through the sieving effect provided by the agarose gel. The smaller the fragment size, the farther it moves. The separated DNA fragments are stained with ethidium bromide followed by exposure to UV radiation. The DNA fragments are seen as orange-coloured bands and are cut out from the agarose gel and extracted. This step is called elution.



21. Endothermic animals regulate their body temperature by physiological means and maintain a more or less constant internal temperature even when the temperature outside fluctuates. This helps them to maintain their biochemical pathways and enzymes act at their maximum at a temperature near 37°C. Therefore, these animals are able to remain active even under cold conditions by exhibiting different types of adaptations to minimise the loss of heat.

22. The sedimentary cycle involves recycling of various minerals such as phosphorus or sulphur of the lithosphere or soil between living and non-living components. Its main features are

- (i) It is a cycle where the nutrients are not lost from the system but are recycled again.
- (ii) It operates through soil, water bodies, air and living organisms.
- (iii) It converts the nutrients into a usable form with the help of decomposers.

23. Preventive strategies to control air pollution:

- (i) Suitable fuel selection (e.g. fuel with low sulphur content) and its efficient use to reduce the pollutant level in emission.
- (ii) Modifications in industrial processes and equipment to reduce emissions.
- (iii) Correct selection of the manufacturing site and zoning for industrial setup to disperse pollution sources.

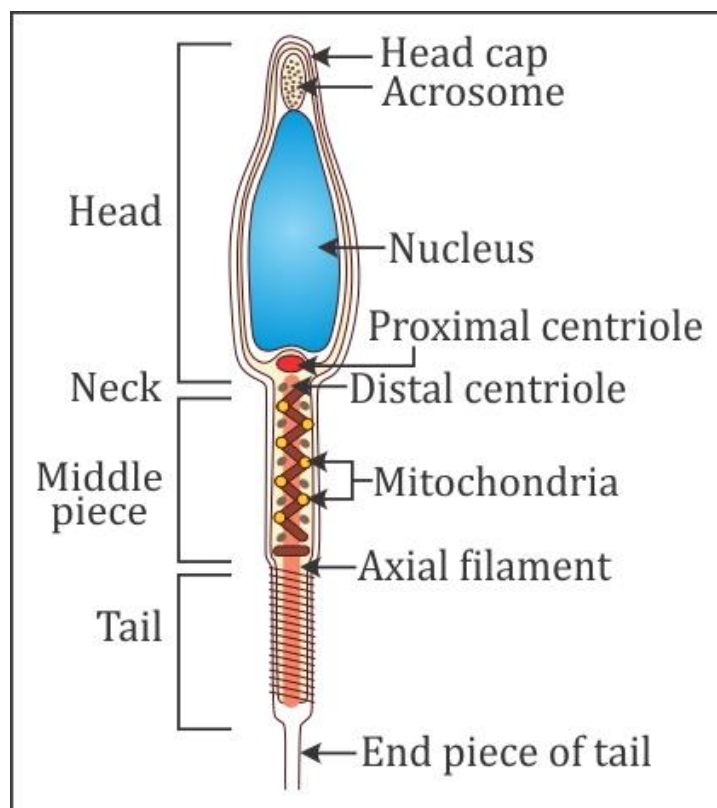
24. RNA is the first genetic material because

- (i) RNA can store genetic information like DNA and act as an enzyme to catalyse reactions.
- (ii) RNA is involved in metabolism, genetic translation and transcription.
- (iii) RNA can self-replicate.

Section D

25. The human sperm is a microscopic, long, flagellated and haploid motile cell and has a head, neck, middle piece and tail.

- (i) Head: It constitutes the anterior region of the sperm. It contains the nucleus and acrosome. The nucleus is a narrow, flat and oval structure consisting of densely packed nuclear chromatin material. The latter is formed of DNA and nucleoprotein. A small pointed sheathy acrosome is found at the anterior region of the head and is derived from the Golgi bodies. It contains the hydrolytic enzyme hyaluronidase which helps the sperm to penetrate the ovum during fertilisation by dispersing the cells of corona radiata.
- (ii) Neck: It is a very short or indistinguishable region lying in between the head and middle piece. It contains the proximal and distal centriole with 9 + 0 arrangement of microtubules. The proximal centriole forms the spindle in the first cleavage division of the fertilised ovum. The distal centriole gives rise to many fine micro-tubules which run up to the sperm tail by passing through the middle piece.



- (iii) Middle piece: It is a cylindrical region lying behind the neck. It contains a mitochondrial spiral (nebenkern) which encircles the axial filament arising from the distal centriole. The mitochondrial spiral contains the oxidative enzymes which provide energy for movement of the sperm by the process called oxidative phosphorylation.

- (iv) Tail: It is the longest part of the sperm and is formed of the main central axial filament and the outer protoplasmic sheath with a small amount of the cytoplasm. At the posterior end of tail, the axial filament is naked without any sheath and is called the end piece. The tail undulates rapidly and provides mobility to the sperm with the head forward in the fluid medium.

OR

Foetal membranes: The developing foetus in the uterus of the mother forms four membranes and these are called foetal membranes. These include chorion, amnion, allantois and yolk sac.

- (i) Chorion: It consists of the outer ectoderm and the inner mesoderm. This layer forms the placental villi and completely envelops the foetus to provide protection.
- (ii) Amnion: It consists of the outer mesoderm and the inner ectoderm. A space is formed between the amnion and the foetus and is called the amniotic cavity. This cavity fills up with a clear watery fluid—amniotic fluid—secreted by the foetus and the membrane. This fluid provides protection to the developing foetus against desiccation, mechanical injury and shock.
- (iii) Allantois: It is a sac-like structure consisting of the inner endoderm and the outer mesoderm. It originates from the primitive gut of an embryo near the yolk sac. It supplies blood vessels to the placental villi.
- (iv) Yolk sac: It is considered vestigial in human beings. It consists of the inner endoderm and the outer mesoderm. In macrolecithal eggs of birds, the vitelline arteries and veins connect the yolk sac with the heart of an embryo. The enzymes of the yolk sac digest the yolk into a soluble form. The vitelline vein carries these soluble forms of the yolk to the heart from where these are circulated to all parts of the developing embryo.

26. Walter Sutton and Theodor Boveri proposed the chromosome theory of inheritance. Its main features are

- (i) Each chromosome carries several specific determiners which play an essential role in the development of an organism. A loss of complete chromosome or its fragment leads to deviation in the structure and function of an organism.
- (ii) The somatic cell of an organism bears two identical sets of chromosomes (diploid) each received from mother (maternal chromosome) and father (paternal chromosome). These two chromosomes of one type constitute the homologous pair.
- (iii) The paired homologous chromosomes separate during meiosis, and each gamete receives one homologous chromosome.
- (iv) The paired condition of both chromosomes is maintained during fertilisation
- (v) Each chromosome contains numerous genes and the position assigned to each gene is called locus. These genes help the organism to develop from the zygote.
- (vi) Each chromosome retains its individuality, uniqueness and continuity throughout the life of an organism and from generation to generation. They never get lost or mixed up but behave as units.

OR

DNA fingerprinting is a well-known method of identifying criminals by means of their DNA. The technique is used to find out variations in individuals of a population at the DNA level. It works on the principle of polymorphism in DNA sequences.

Process of DNA fingerprinting:

- (i) The DNA is extracted from the nuclei of whatever evidence is available. From WBCs in case of blood sample, from hair follicle cells which cling to the roots of hair which have fallen or have been pulled out or from spermatozoans in a semen sample.
- (ii) If the content of DNA is limited, then DNA can be amplified by making many copies by using the polymerase chain reaction (PCR).
- (iii) The DNA sample is digested by a restriction enzyme which cuts the DNA into fragments at specific sites. The number of these sites present in an individual's DNA dictates the number and size of DNA fragments generated by the enzymes.
- (iv) These fragments are separated by a gel electrophoresis setup containing agarose polymer gel. The separated fragments can be visualised by staining them with a dye which fluoresces under ultraviolet radiation.
- (v) Double-stranded DNA is then split into single-stranded DNA using alkaline chemicals.

- (vi) These separated DNA sequences are transferred to a nylon or nitrocellulose sheet placed over the gel. This is called 'Southern Blotting'.
- (vii) The nylon sheet is then immersed in a bath and probes or markers which are radioactive, synthetic DNA segments of known sequences are added. The probes target a specific nucleotide sequence which is complementary to VNTR sequences and hybridise them.
- (viii) Finally, X-ray film is exposed to the nylon sheet containing radioactive probes. Dark bands develop at the probe sites which look something like the bar codes used to identify items at the grocery store.
The degree of variation is so high that every individual except for identical twins produces a unique band pattern, just as every individual has a unique fingerprint.

27. Decomposition is the process of breaking down a substance into its constituent parts. Dead remains of plants and animals are called detritus.

The decomposition is a complex, enzymatic process which involves stepwise degradation of detritus. It involves the following steps:

- (i) **Fragmentation:** It is the process of breaking of the detritus into smaller particles or fragments by detritivores. Fragmentation increases the surface area of detritus particles for the microbial action.
- (ii) **Leaching:** Soluble substances such as sugars and several nutrients from the fragmented detritus particles get dissolved in water percolating through the soil and are removed because of leaching action.
- (iii) **Catabolism:** This process is carried out by decomposers which release extracellular enzymes to decompose detritus particles to simpler compounds and inorganic substances.
- (iv) **Humification:** It is the process by which simplified detritus gets converted to a dark-coloured amorphous substance called humus in the soil.
- (v) **Mineralisation:** It is the process resulting in the release of inorganic substances such as carbon dioxide, water and nutrients.

OR

- (a) Negative or antagonistic interactions are the population interactions in which one species is harmed and the other is benefited. These include amensalism, competition, parasitism and predation.
- (b) Predation is a temporary interaction between two organisms where one organism captures, kills and eats up the other. The organism which captures and eats up the other organism is called predator and which is eaten is called prey. Example: Tiger (predator) eats goat or deer (prey).
- (c) Predator-prey relationship is useful to both organisms because predators keep check on the prey and maintains a balance. In a community, if the population of

predators decreases, then the population of the prey increases which leads to starvation.

- (d) When an organism feeds on the members of its own species, it is called a cannibal and the phenomenon is called cannibalism. Example: Female spider eats the male after mating.