Class XII Session 2023-24
Subject - Biology
Sample Question Paper – 6

Maximum Marks: 70 **Time: 3 Hours**

General Instructions:

(i) All questions are compulsory.
(ii) The question paper has five sections and 33 questions. All questions are compulsory.
(iii) Section-A has 16 questions of 1 mark each; Section-B has 5 questions of 2 marks each; Section- C has 7 questions of 3 marks each; Section- D has 2 case-based questions of 4 marks each; and Section-E has 3 questions of 5 marks each.
(iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
(v) Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION-A

Which of the following phenomena was experimentally proved by Meselson and Stahl?
(a) Transformation
(b) Transduction
(c) Semi-conservative DNA replication
(d) Central dogma

2. Refer to the given table of contrasting traits in pea plants studied by Mendel.

S.No.	Character	Dominant trait	Recessive trait
(i)	Seed colour	 Green	 Yellow
(ii)	Flower colour	 Violet	 White

(iii)	Pod shape	 Full	 Constricted
(iv)	Flower position	 Terminal	 Axial

Which of the given traits are incorrectly placed?
(a) (i), (ii) and (iii) only
(b) (ii), (iii) and (iv) only
(c) (i) and (iv) only
(d) (iii) only

3. Fitness according to Darwin refers to
(a) number of species in a community
(b) useful variation in population
(c) strength of an individual
(d) reproductive fitness of an organism.

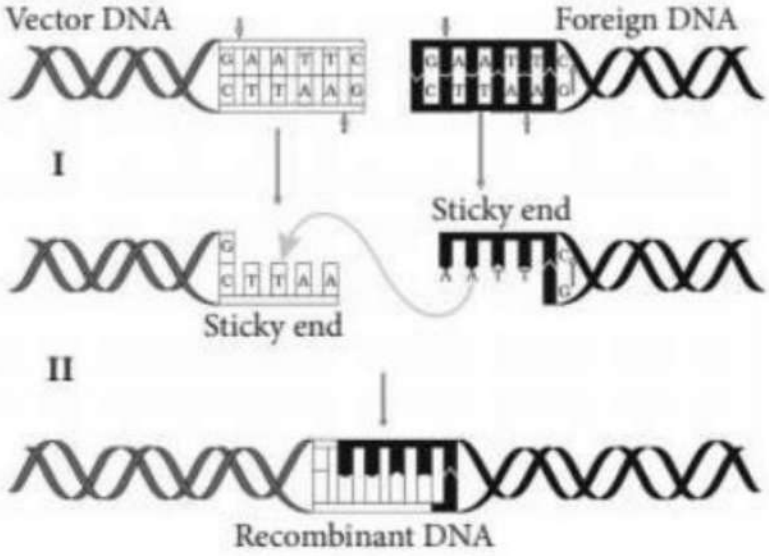
4. The biomass available for consumption to heterotrophs and the rate of formation of new organic matter by consumers are referred to as
(a) gross primary productivity and net primary productivity respectively
(b) net primary productivity and gross primary productivity respectively
(c) gross primary productivity and secondary productivity respectively
(d) net primary productivity and secondary productivity respectively.

5. Big holes in Swiss cheese are made by a
(a) a machine
(b) a bacterium that produces methane gas
(c) a bacterium producing a large amount of carbon dioxide
(d) a fungus that releases a lot of gases during its metabolic activities.

6. In pBR322, tetracycline resistance gene (tet) has recognition site for which of the following restriction endonuclease?
(a) Hind III
(b) useful variation in population

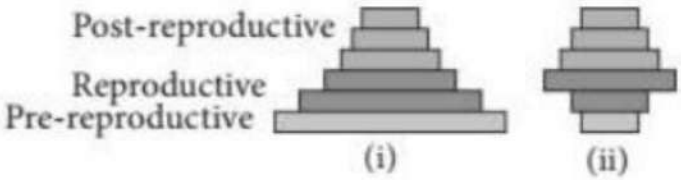
(c) EcoRI
(d) Pst I

7. Study the following figures and identify the enzymes involved in steps I and II respectively.



(a) EcoRI and DNA ligase
(b) Hind II and DNA ligase
(c) EcoRI and Hind II
(d) Restriction endonuclease and exonuclease

8. What does the shape of the given age pyramids reflects about the growth status of the related population?



(i)
(a) Expanding
(b) Stable
(c) Expanding
(d) Declining
(ii)
Stable
Declining

Declining
Stable

9. Along with nicotine, cigarette smokers also have the intake tars, phenols, hydrocarbons, arsenic and many
other chemicals. Which of the following is not an effect of smoking tobacco?
(a) Narrowing or hardening of blood vessels in the heart and brain
(b) A higher frequency of respiratory infections (e.g., cold, pneumonia)
(c) A higher risk of cancer, including cancer of the lungs, mouth, larynx, bladder and kidneys
(d) None of these

10. Ernst Chain and Howard Florey's contribution was
(a) establishing the potential of penicillin as an effective antibiotic
(b) discovery of streptokinase
(c) production of genetically engineered insulin
(d) discovery of DNA sequence.

11. What is the correct sequence of sperm formation?
(a) Spermatogonia, spermatozoa, spermatocytes, spermatids
(b) Spermatogonia, spermatocytes, spermatids, spermatozoa
(c) Spermatids, spermatocytes, spermatogonia, spermatozoa
(d) Spermatogonia, spermatocytes, spermatozoa, spermatids

12. Which of the following approaches does not give the defined action of contraceptive?

(a)	Hormonal contraceptives	Prevent/retard entry of sperms, prevent ovulation and fertilisation
(b)	Vasectomy	Prevents spermatogenesis
(c)	Barrier methods	Prevent fertilisation
(d)	Intra uterine devices	Increase phagocytosis of sperms, suppress sperm motility and fertilising capacity of sperms

Question No. 13 to 16 consist of two statements - Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

13. Assertion: The introduction of Nile perch in lake Victoria caused cichlids to become extinct.
Reason: Nile perch is an indigenous species of East Africa.

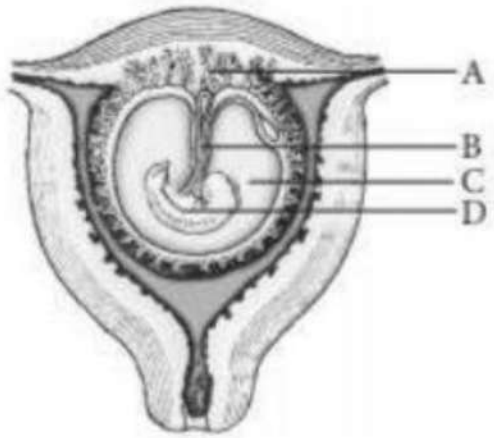
14. Assertion: Offsite collections can be used to restock depleted populations, reintroduce species in the wild and restore degraded habitats.
Reason: In situ conservation refers to the conservation of endangered species in their natural habitats.

15. Assertion: Biodiversity hotspots are the regions which possess low levels of species richness, high degree of endemism and no loss to habitats.
Reason: Total number of biodiversity hotspots in the world is 34 with three of these hotspots found in India.

16. Assertion: Only the pre-pollination growth of male gametophyte occurs inside the microsporangium whereas the remaining growth occurs over the female reproductive organs.
Reason: The complete growth of female gametophyte occurs inside the megasporangium.

SECTION-B

17. The following figure shows a fetus within the uterus. On the basis of the given figure, answer the questions that follow.



(i) In the given figure, identify the correct part among A, B, C and D that acts as a temporary endocrine gland and substantiate your answer. Why is it also called the functional junction?
(ii) Mention the role of B in the development of the embryo.

18. In Pisum sativum, the pod colour may be green (G) or yellow (g). What percentage of offsprings with green pod colour trait would be obtained in a cross of Gg x Gg?

19. (a) What precaution(s) would you recommend to a patient requiring repeated blood transfusion?
(b) If the advise is not followed by the patient, there is an apprehension that the patient might

contract a disease that would destroy the immune system of his/her body. Explain with the help of schematic diagram only how the immune system would get affected and destroyed.

20. What are recombinant proteins? How do bioreactors help in their production?

21. Construct a pyramid of biomass starting with phytoplanktons. Label 3 trophic levels. Is the pyramid upright or inverted. Give reason.

OR

Construct an ideal pyramid of energy when 1,00,000 joules of sunlight is available. Label all its trophic levels.

SECTION-C

22. Name and explain the role of the inner and middle walls of the human uterus.

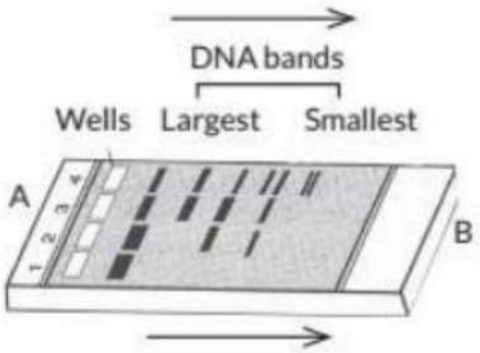
23. Explain three different modes of pollination that can occur in a chasmogamous flower.

24. Construct and label a transcription unit from which the RNA segment given below has been transcribed. Write the complete name of the enzyme that transcribed this RNA.

25. As we know that evolution occurs, when the genetic equilibrium is upset,
(a) List any four factors which affect genetic equilibrium.
(b) Describe Founder's effect.
(c) What kind of evolution is shown by vertebrate brains?

26. What is the functional difference between B-cells Mention any two human diseases caused by roundworms alongwith their causative agents and their mode of transmission into the human body.

27. Given below is the diagram representing the observations made for separating DNA fragments by gel electrophoresis technique. Observe the illustration and answer the questions that follow.



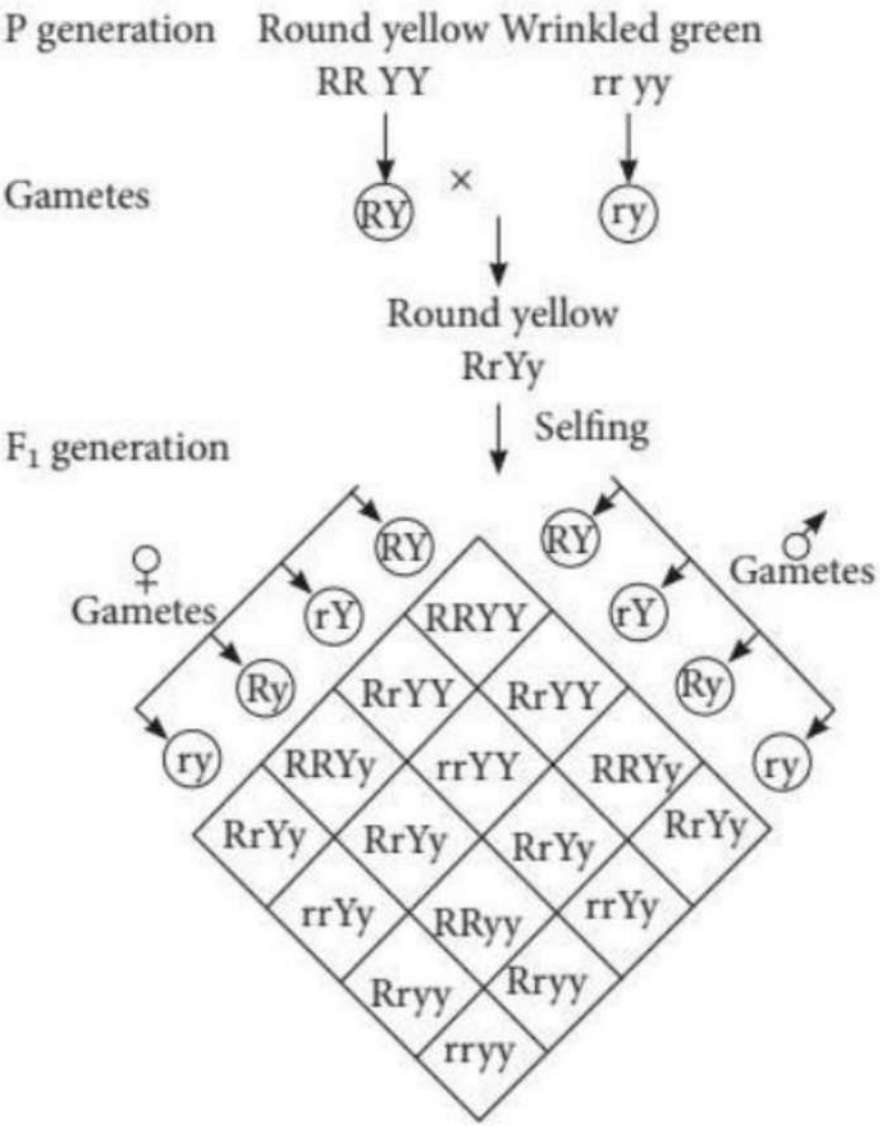
(a) Why are the DNA fragments seen to be moving in the direction A→B?
(b) Write the medium used in which DNA fragments separate.
(c) Mention how the separated DNA fragments can be visualised for further technical use.

28. Since the origin of life on earth, there were five episodes of mass extinction of species.
(a) How is the 'Sixth extinction, presently in progress, different from the previous episodes?
(b) Who is mainly responsible for the 'Sixth extinction'?
(c) List any four points that can help to overcome this disaster.

SECTION-D

Q. No. 29 and 30 are case based questions. Each question has 3 subparts with internal choice in one subpart.

29. A scientist crosses homozygous round yellow seeded pea plant to homozygous wrinkled green seeded pea plant and observed the inheritance of both traits as per the following pattern. He collected total 1600 seeds in F_2 generation.

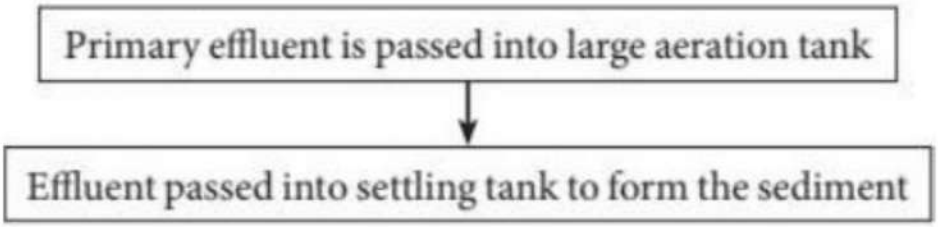


(a) How many seeds would be homozygous for round shape and green colour in F_2 generation?

OR

How many seeds could be heterozygous for round shape and yellow colour in F_2 generation?
(b) What phenotypic ratio would be obtained if the plants of F, generation would be crossed with wrinkled green seeded plant?
(c) What would be the total number of seeds heterozygous for yellow colour and homozygous for round seed shape?

30. Large quantities of sewage is generated everyday in cities and towns, which is treated in Sewage Treatment Plants (STPs) to make it less polluted. Given below is the flow chart of one of the stages of STP. Observe the given flow chart and answer the questions accordingly.



(a) Why large aeration tanks are important for primary effluent?
(b) Write the significance of activated sludge.
(c) Explain the digestion step in the formation of biogas.

OR

Explain the role of flocs in the given sewage treatment plant (STP).

SECTION – E

31. Mention the role of gonadotropins in menstrual cycle. On what day of the menstrual cycle do the gonadotropins reach a peak?

OR

Angiosperm flowers may be monoecious, cleistogamous or show self incompatibility. Describe the characteristic features of each one of them and state which one of these flowers promotes inbreeding and outbreeding.

32. (a) What is a genetic code?
(b) Explain the following:
(i) Degenerate codon; (ii) Unambiguous codon; (iii) Initiator codon.

OR

Name and describe the technique that will help in solving a case of paternity dispute over the custody of a child by two different families.

33. (a) A recombinant vector with a gene of interest inserted within the gene of B-galactosidase enzyme, is introduced into a bacterium. Explain the method that would help in selection of recombinant colonies from non-recombinant ones.
(b) Why is this method of selection referred to as "insertional inactivation"?

OR

Rahul was having a debate with Rohan regarding the advantages and disadvantages of transgenic animals. Rahul viewed that the production of transgenic animals violates the

integrity of species and animals suffer from cruelty so, it is unethical. On the other hand, Rohan emphasised the benefits that transgenic animals provide to the human race in various fields especially medicine.

(a) How do transgenic animals benefit humans?

(b) List the ethical issues related with the production of transgenic animals.

SOLUTIONS

1. (c): The Meselson and Stahl experiment was an experiment to prove that DNA replication was semi- conservative and it was first shown in Escherichia coli and subsequently in higher organisms, such as plants and human cells. Semi-conservative replication means that when the double stranded DNA helix was replicated, each of the two double stranded DNA helices consisted of one strand coming from the parental helix and one is newly synthesised.

2. (c)

3. (d): The fitness, according to Darwin, refers ultimately to reproductive fitness. Hence, those who are better fit in an environment, have more progeny than others. These, therefore, will survive more and are selected by nature. He called it natural selection and implied it as a mechanism of evolution.

4. (d)

5. (c) Ripened cheese is prepared from unripened cheese by first dipping in brine, wiping and then maturation with different strain of bacteria and fungi. It takes 1-16 months for ripening. Large holed Swiss cheese is ripened with the help of CO_2 producing (causing holes) bacterium called Propionibacterium shermanii.

6. (b) In plasmid vector pBR322, two unique restriction sites Pst I and Pvu I are located within the amp gene and BamHI, Sal I, etc., are located within the tet gene. When restriction enzyme BamHI or Sal I is used, the DNA insert is placed within the gene tet making it nonfunctional.

7. (a)

8. (c) Triangular age pyramid has high proportion of pre-reproductive individuals, moderate number of reproductive individuals and fewer post-reproductive individuals. It represents young or rapidly growing population. In urn-shaped age pyramid, the number of reproductive individuals is higher than the number of pre-reproductive individuals. It represents declining or diminishing population with negative growth.

9. (d): Cigarette smoking has a lot of ill effects on body. Benzopyrene present in tobacco smoke causes lung and throat cancer. Cigarette smoking is a major CHD (coronary heart disease) risk factor for

cardiovascular diseases. Tobacco smoke also irritates the mucous membrane of the throat and bronchi causing cough and bronchitis. It may breakdown the lung alveoli which reduces the surface for gas exchange.

10. (a) Penicillin was the first antibiotic to be discovered by Alexander Fleming (1928). He found that fungus Penicillium notatum or its extract could inhibit the growth of bacterium Staphylococcus aureus. However, its full potential as an effective antibiotic was established much later by Ernst Chain and Howard Florey. This antibiotic was extensively used to treat American soldiers wounded in the World War II. Fleming, Chain and Florey were awarded the Nobel prize in 1945, for this discovery.

11. (b)

12. (b): Vasectomy is sterilisation procedure in males where a small part of the vas deferens is removed or tied up through a small incision on the scrotum. It prevents gamete transfer and thereby prevent conception.

13. (c)

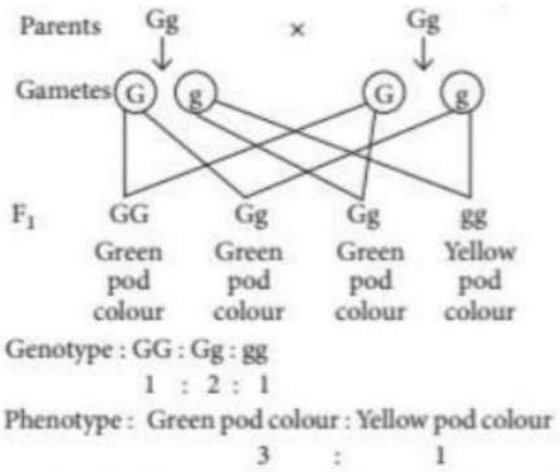
14. (b)

15. (d) Hotspots are area of high endemism and high level of species richness. These hotspots are also regions of accelerated habitat loss. 34 hotspots have been identified in the world. Three of them - Western Ghats and Sri Lanka - Indo Burma and Himalaya are found in India.

16. (b)

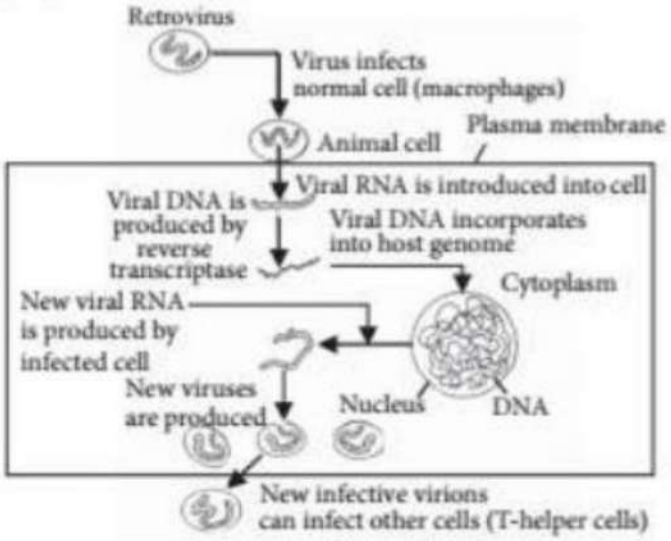
17. (i) Part labelled as A is placenta. It acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc. It is also called the functional junction because it facilitates the supply of oxygen and nutrients to the embryo and removes carbon dioxide and excretory or waste materials produced by the embryo.
(ii) The labelled part B is umbilical cord. Placenta is connected to the embryo through an umbilical cord which helps in the transport of substances to and from the embryo.

18. In Pisum sativum, green pod colour is dominant over yellow. Thus, the cross between Gg x Gg will be:



Thus, 75% of offsprings will produce green pod colour.

19. (a) If a patient requires repeated blood transfusion, it should be ensured that donor's blood has been screened for HIV and the syringes used should be new and disposable.
(b) If the patient does not follow these precautions, then he/she might get infected with HIV which causes AIDS (Acquired Immuno Deficiency Syndrome). AIDS is a disorder of cell mediated immune system of the body. There is a reduction in the number of helper T-cells which stimulate antibody production by B-cells. This results in the loss of natural defence of the body against viral infection.

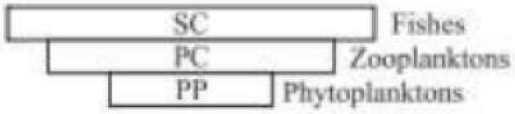


Thus, the immune system gets hampered due to the action of AIDS virus on T-lymphocytes and macrophages.

20. Recombinant protein is a protein obtained by introducing recombinant DNA into a heterologous host and causing it to produce the gene product. Bioreactors are vessels in which raw materials are biologically converted into specific products. A bioreactor provides the

optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen). To maintain a higher yield, optimum temperature must be maintained and suitable pH must be provided.

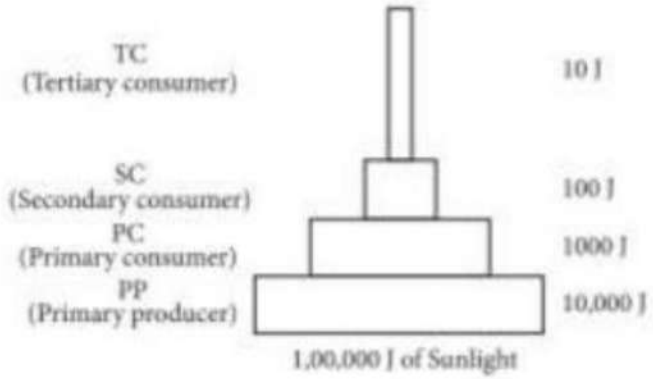
21. Pyramid of biomass starting with phytoplanktons will be for an aquatic ecosystem. It can be drawn as follows:



The pyramid of biomass in aquatic ecosystem is generally inverted because the biomass of fishes far exceeds that of phytoplanktons.

OR

An ideal pyramid of energy with primary producers when 100000 I of sunlight available is shown below:

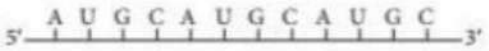


22. The inner glandular wall of the uterus is known as endometrium while the middle wall of the uterus is known as myometrium. During the menstrual cycle, the endometrium wall grows into a thick, vascular (blood vessel-rich) glandular layer. This condition of the endometrium favours the implantation of the fetus. If fertilisation does not occur, the endometrium is shed during the hemorrhagic phase of the menstrual cycle. Myometrium consists of smooth muscles. It exhibits contraction during delivery of the baby.

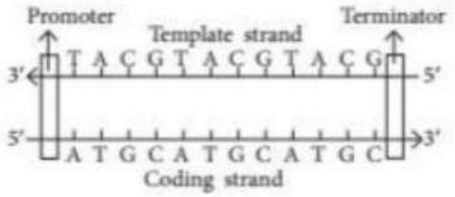
23. A chasmogamous flower can undergo
(i) Autogamy: It is a type of self pollination where pollens of a flower fertilise the stigma of the same flower. Autogamy is possible only when anther and stigma are close together and there is synchrony in pollen release and stigma receptivity.

(ii) Geitonogamy: It is a type of pollination in which pollens of one flower fertilise the stigma of another flower present on the same plant or genetically similar plant.
(iii) Xenogamy or cross pollination: It is a type of pollination in which pollens of one flower fertilise the stigma of another flower present on different plant
of same species. It is performed with the help of an external agency.

24. RNA segment that has been transcribed from a transcription unit which has the polarity (5′→ 3′) have uracil in the place of thymine. Given RNA strand:



For the given RNA, the transcription unit is given as:



DNA dependent RNA polymerase is an enzyme that transcribed this RNA segment.

25. (a) Factors affecting genetic equilibrium are gene flow, mutation, natural selection and genetic recombination.
(b) When a few individuals or a small group of individuals from a large population invades a new or isolated geographical region, these become the founders. These founders carry on a limited portion of the parental gene pool. Their gene pool may contain certain alleles in a very low frequency or may lack a few alleles. As a result of the loss of genetic variation the new population may be distinctively different (genotypically and phenotypically) from the parent population. Formation of different genotype in new settlement is called Founder's effect. (c) Vertebrate brains are homologous organs, hence they show divergent evolution.

26. Differences between B-Lymphocytes (B-cells) and T-Lymphocytes (T-cells) are as follows:

S. No.	B-Lymphocytes (B-cells)	T-Lymphocytes (T-cells)
(i)	B-cells form humoral or antibody-mediated immune system.	T-cells form cell-mediated immune system.
(ii)	They defend against viruses and bacteria that enter the blood and lymph.	They defend against pathogens including protists and fungi that enter the cells.
(iii)	Plasma cells formed by division of B-cells produce antibodies and provide immunity against foreign substances.	T lymphocytes produce different types of T-cells where killer T-cells react against cancer cells and suppressor cells inhibit immune system.

OR

Roundworms are nematodes, responsible for helminthic diseases in humans. Two human diseases caused by roundworms are:
(i) Ascariasis - It is caused by Ascaris lumbricoides and spreads through contaminated fruits, water, vegetables, etc.
(ii) Filariasis - It is caused by Wuchereria bancrofti, and W. malayi. It is transmitted by the bite of female Culex mosquito.

27. (a) In gel electrophoresis, DNA molecules migrate in the direction of electrode bearing opposite charge on the basis of size. The smaller the fragment, the farther it moves.
(b) The most commonly used medium or matrix is agarose which is a polysaccharide extracted from sea weeds.
(c) The separated DNA fragments can be seen only
after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiations as bright orange coloured bands.

28. (a) Sixth extinction, ie, the current species extinction is 100-1000 times faster than extinctions in pre-human times.
(b) Human activities like settlements, hunting, over exploitation and habitat destruction are

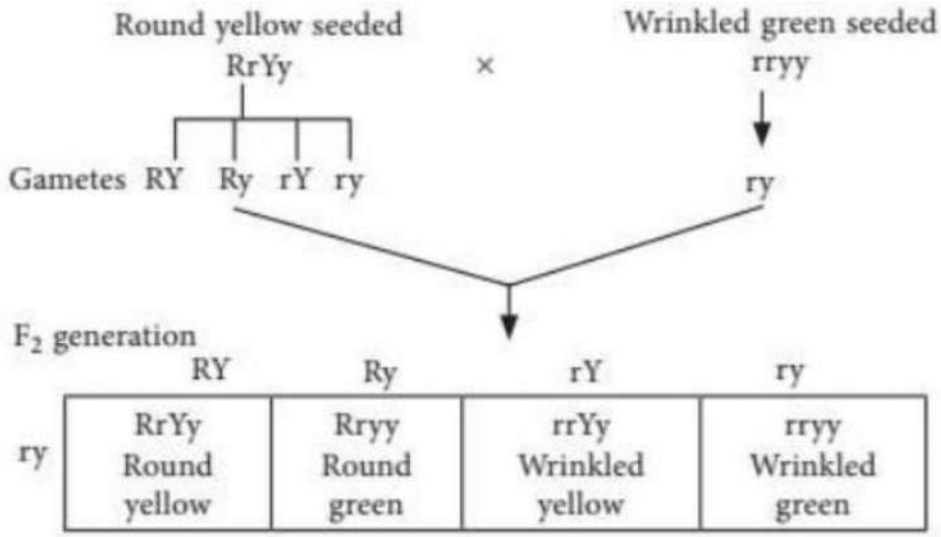
mainly responsible for 'Sixth extinction.
(c) This disaster can be overcome by the following ways:
(i) Planting large number of trees on road sides and where space is available.
(ii) Avoid introduction of invasive alien species.
(iii) Conserving biodiversity by maintaining National parks, zoos, etc.
(iv) Deforestation and fragmentation of forested areas should be stopped.

29. The given cross represents the dihybrid cross. The total number of seeds produced in F2 generation are 1600.
(a) According to the given cross, the seeds homozygous for round shape and green colour are 1/16. Therefore, the total number of round green seeds obtained is 100 (RRyy). Homozygous round green seeds = 1/16 × 1600 = 100

OR

According to the given cross, the seeds heterozygous for round shape and yellow colour are 4/16 (RrYy). Therefore, the total number of round yellow seeds
$= \frac{4}{16} \times 1600 = 400$

(b) The cross between F1 hybrids with wrinkled green seeded plants (rryy) can be explained with the help of following cross:



The phenotypic ratio obtained in F2 generation is 1:1:1:1 and the genotypic ratio obtained in F2 generation is 1:1:1:1. (c) The analysis of cross reveals that the number of seeds heterozygous for yellow colour and homozygous for round seed shape are 2 out of 16. (RRYy) Therefore, the

total number of seeds heterozygous for yellow colour and homozygous for round seed shape are: = 2/16 × 1600 = 200

30. (a) Primary effluent is passed into large aeration tank for vigorous growth of useful aerobic microbes into flocs.
(b) Activated sludge is the term used for the sediment formed. Some of it is pumped back into the aeration tank to serve as an inoculum.
(c) During digestion, the major part of activated sludge is passed into a large tank called anaerobic sludge digester. Here, aerobic microbes (if present in the sludge) get killed. Anaerobic microbes digest the organic matter as well as aerobic microbes of the sludge. During this digestion, bacteria produce a mixture of gases (CH_4, CO_2, H_2S, etc.). These gases form biogas and can be used as source of energy.
During secondary treatment, the primary effluent is taken to aeration tanks. A large number of aerobic heterotrophic microbes grow in the aeration tank. They form flocs which are masses of bacteria held together by slime and fungal filaments to form mesh like structures. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As a result, the BOD of the waste matter is reduced to 10- 15% of raw sewage, it is passed into settling tank.

31. LH and FSH secreted by pituitary gland are called gonadotropins. The secretion of FSH and LH increases gradually during the follicular phase and stimulates the development of follicles as well as secretion of estrogens by the growing follicles. Both gonadotropins reach a peak level in the middle of the cycle (14th day). LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation). This ovulatory phase is followed by luteal phase during which LH stimulates the remaining cells of the Graafian follicle to transform into corpus luteum which secretes large amounts of progesterone needed for maintenance of endometrium. In the absence of fertilisation, LH production gets reduced leading to degeneration of corpus luteum. This causes disintegration of endometrium leading to menstruation.

OR

Monoecious flowers are bisexual, i.e., they bear both male and female reproductive organs on the same plant, e.g., maize.
Cleistogamous flowers are those flowers which do not open at all. These flowers are bisexual and remain closed causing self pollination. In cleistogamous flowers, the anthers dehisce inside closed flowers. Growth of style brings the pollen grains in contact with stigma. Pollination and seed setting are assured. Pollinators are not required, e.g., Commelina benghalensis, balsam.
Self incompatibility is inability of pollen of a plant to fertilise the pistil of the same plant, e.g.,

Primula. Monoecious and cleistogamous flowers promote inbreeding whereas self incompatibility in plants promotes outbreeding.

32. (a) The relationship between the sequence of amino acids in a polypeptide and nucleotide sequence of DNA or mRNA is called genetic code.
(b) (i) Degenerate codon : More than one codons code for a single amino acid. In degenerate codons, generally the first two nitrogen bases are similar while the third one is different. E.g., UUU and UUC code for phenylalanine.
(ii) Unambiguous codon : Codons that specify only one amino acid and not any other. E.g., AUG codes for methionine.
(iii) Initiator codons: The start codon is the first codon of mRNA transcript. It initiates the process of translation. E.g., AUG.

OR

DNA fingerprinting technology is a technique of determining nucleotide sequences of certain portion of DNA which are unique to each individual. DNA fingerprints can be prepared from extremely minute amounts of blood. semen. hair bulb or certain other cells of the body. The major steps are as follows:
(i) DNA is extracted from the cells. It is cut into fragments with the help of restriction enzymes. The fragments of DNA also contain VNTRS (Variable Number Tandem Repeats) which vary in number from person to person.
(ii) DNA fragments are separated by passing through gel electrophoresis.
(iii) Separated DNA sequences are transferred from gel onto a nitrocellulose or nylon membrane.
(iv) Radioactive DNA probes complementary to VNTRs are poured over the nylon membrane. Some of them bind with VNTRS (Southern Blotting).
(v) X-ray film is exposed to the nylon sheet which gives dark bands at the probe sites. Thus, hybridised fragments are detected by autoradiography. The dark bands on X-ray film represent the DNA fingerprints (DNA profiles).

33. (a) Insertional inactivation refers to the process where insertion of rDNA within the coding sequence of an enzyme causes its inactivation. The non recombinants having intact functional gene, e.g. B-galactosidase produce blue colour with chromogenic substrate but when rDNA is inserted within the coding sequence of enzyme B-galactosidase, recombinants do not produce any colour. Hence, recombinants can be easily differentiated from non recombinants due to insertional inactivation.

(b) In this method, insertion of recombinant DNA in the coding sequence of enzyme B-galactosidase causes its inactivation, hence named insertional inactivation.

OR

(a) Benefits derived from transgenic animals are as follows:
(i) They produce useful biological products, that can be created by introduction of portion of gene, which codes for a particular product such as human protein
(a-1-antitrypsin) from transgenic sheep is used to treat emphysema.
(ii) Transgenic mice are being developed for use in testing the safety of vaccine before they are used for humans.
(iii) They carry genes which make them more sensitive to toxic substances than non-transgenic animals. They are then exposed to toxic substances and the effects are studied.
(iv) Transgenic animals can be specifically designed to allow the study of how genes are regulated and how they affect the normal functions of the body and its development, e.g., study of complex factors involved in growth such as insulin-like growth factor.
(v) Many transgenic animals are designed to increase our understanding of how genes contribute to the development of disease. Today transgenic models exist for many human diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's.
(b) The ethical issues concerned with the production of transgenic animals include:
(i) Use of animals in biotechnology causes great suffering to them.
(ii) It is disrespectful to living beings, and only exploits them for the benefit of human beings.