

Sample Question Paper (Solved)–2025

(Issued by Central Board of Secondary Education, New Delhi)

CLASS–12th BIOLOGY (THEORY)

Time allowed : 3 Hours

Maximum Marks : 70

General Instructions :

- All questions are compulsory.
- The question paper has five sections and 33 questions.
- 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.
- 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.
- Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION—A

Q. No. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

Q. 1. Signals for parturition in human female originate from : 1

- Fully developed foetus only
- Both placenta as well as fully developed foetus
- Placenta only
- Oxytocin released from maternal pituitary.

Ans. (B) Both placenta as well as fully developed foetus.

Q. 2. To produce 1600 seeds, the number of meiotic divisions required will be : 1

- 2400
- 2000
- 1600
- 1800

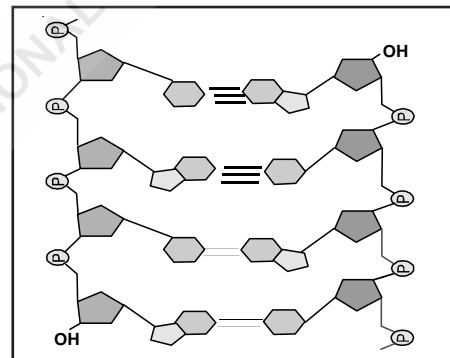
Ans. (B) 2000.

Q. 3. A sample of normal double-stranded DNA was found to have thymine content of 27%. What will be the expected proportion of guanine in this strand ? 1

- 23%
- 32%
- 36%
- 73%

Ans. (A) 23%.

Q. 4. Observe the schematic diagram that depicts a small section of nucleic acid. The bases in two strands are paired through hydrogen bonds that are shown by the dark lines. Identify the correct sequence of nucleotide in the 5'-3' direction. 1



- GCAT
- CGTA
- TAGC
- ATCG

Ans. (B) CGTA.

Q. 5. Suresh and Rajesh have defective haemoglobin due to genetic disorders. In Suresh, the problem is qualitative as he is having incorrectly functioning globin molecules while in Rajesh the problem is quantitative as he is having very few globin molecules. Identify the disorder they are suffering from. 1

Suresh	Rajesh
A Thalassaemia—Autosomal Dominant blood disorder	Sickle Cell Anaemia—Autosomal linked Dominant trait
B Sickle Cell Anaemia—Autosomal linked Dominant trait	Thalassaemia—Autosomal Recessive blood disorder
C Sickle Cell Anaemia—Autosomal linked Recessive trait	Thalassaemia—Autosomal Recessive blood disorder
D Thalassaemia—Autosomal Dominant blood disorder	Sickle Cell Anaemia—Autosomal linked Dominant trait

Ans. (C) Sickle Cell Anaemia -Thalassaemia - Autosomal Autosomal linked Recessive trait Recessive blood disorder

Q. 6. In *E.coli*, the lac operon gets switched on when lactose is : 1

- (A) present in the medium and it binds to the repressor.
 (B) not present in the medium and the repressor binds to the operator.
 (C) not present in the medium and RNA polymerase binds to the operator.
 (D) Active lactose present in the medium binds to RNA polymerase.

Ans. (A) present in the medium and it binds to the repressor.

Q. 7. Which of the following features shows the mechanism of sex determination in honey-bee ? 1

- (i) An offspring formed from the union of a sperm and egg develops as a female.
 (ii) Males have half the number of chromosomes than that of female.
 (iii) The males are haploid having 32 chromosomes.
 (iv) All workers and males are diploid having 16 chromosomes
- (A) (i) and (ii) (B) (ii) and (iii)
 (C) (i) and (iv) (D) (ii) and (iv)

Ans. (A) (i) and (ii)

Q. 8. The following diagram shows a fragment of DNA which is going to be transcribed, the upper strand with polarity 3' to 5' is the template strand : 1

3' ATTGCC 5'

5' TAACGG 3'

After transcription the mRNA can be represented by:

- (A) 5' AUUGCC 3' (B) 5' AUUGCC 3'
 (C) 5' UAACGG 3' (D) 5' GGCAAU 3'

Ans. (C) 5' UAACGG 3'

Q. 9. Idli – dosa dough rises due to production of which of the following gas ? 1

- (A) CO (B) CO₂
 (C) NO (D) NO₂

Ans. (B) CO₂.

Q. 10. Adaptive radiation leads to which of the following ? 1

- (A) Increased competition among species
 (B) Decreased speciation rates
 (C) Limited morphological diversity among species
 (D) Rapid divergence of traits among populations inhabiting a given geographical area.

Ans. (D) Rapid divergence of traits among populations inhabiting a given geographical area.

Q. 11. Eco R1 cuts the DNA between bases G and A only when the sequence of GAATTC is present. The number of nucleotides present in the resultant sticky ends that will be formed in each of the two strands of DNA after this enzyme cuts the DNA will be : 1

	Vector DNA	Foreign DNA
(A)	1 & 5	5 & 1
(B)	2 & 4	4 & 2
(C)	2 & 5	5 & 2
(D)	3 & 4	4 & 3

Ans. (A) 1 & 5 5 & 1

Q. 12. During the secondary treatment of sewage, which of the following change in the effluent occur due to flocs ? 1

- (A) Reduction in BOD (B) Increase in BOD
 (C) Decrease in DO (D) No change in DO or BOD

Ans. (A) Reduction in BOD.

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.

Q. 13. Assertion (A) : Cells of tapetum have more than one nucleus.

Reason (R) : They undergo meiosis without cytokinesis. 1

Ans. (C) A is true but R is false.

Q. 14. Assertion (A) : Deoxyribonucleoside triphosphates serve dual purposes.

Reason (R) : They act as proof readers and provide energy. 1

Ans. (C) A is true but R is false.

Q. 15. Assertion (A) : A floating cover placed over the slurry in a biogas plant keeps on rising.

Reason (R) : This cover keeps on rising due to the gas produced in the tank by the microbial activity. 1

Ans. (A) Both A and R are true and R is the correct explanation of (A)

Q. 16. Assertion (A) : DNA fragments can be isolated by Gel electrophoresis on the basis of their size.

Reason (R) : The larger the fragment size, the faster it moves. 1

Ans. (C) A is true but R is false.

SECTION—B

Q. 17. Attempt either option A or B

(A) (i) A blood test reported negative for hCG. What does negative hCG imply ? Name the tissue which produces hCG.

(ii) If a blood test reported positive for hCG in a person, then which other hormones would also be secreted by the tissue secreting hCG ?

Ans. (i) hCG—Human Chorionic Gonadotropin hCG is produced by placenta.

(ii) Placenta also secretes human placental lactogen (hPL) estrogen, progesterone. It also secretes relaxin in the later phase of pregnancy.

Or

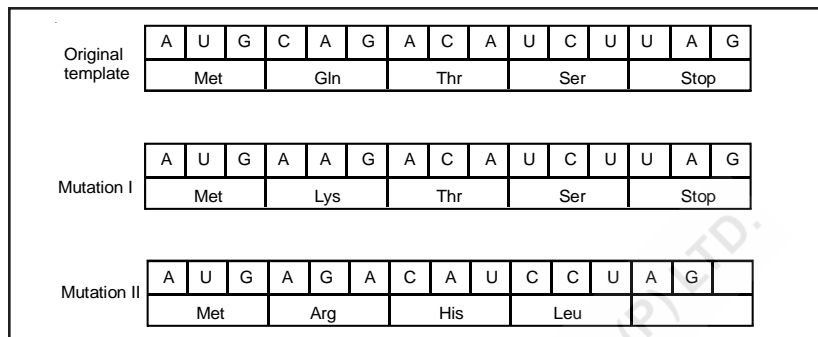
(B) (i) The human male ejaculates about 200 to 300 million sperm during a coitus, however the ovum is fertilized by only one sperm. How does the ovum block the entry of additional sperms ?

(ii) All copulations will not lead to fertilization. Why ?
 Ans. (i) During fertilization, a sperm comes in contact with the **zona pellucida** layer of ovum and induces changes in the membrane that blocks the entry of any other sperm.

(ii) Fertilization can occur only if ovum and sperm are transported simultaneously to the ampullary isthemic junction. This is the reason why not all copulations lead to fertilization and pregnancy.

Q. 18. Attempt either option A or B

(A) The schematic representation given below shows a DNA strand and two types of mutations in the DNA strand. 2



(i) Identify the type of mutation exhibited in I and II.
 (ii) Which of the above mutation is more harmful ? Give reason.

Ans. (1) Mutation I—Point mutation.

Mutation II—Frame-shift mutation.

(ii) Deletion of base pairs of DNA, causes from-shift mutation. It changes the reading frame from the point of insertion and deletion. It changes the complete change of protein. The presence of chromogenic substrate gives blue coloured colonies if the plasmid does not have any new inert in the set up. Thus it help in identification of colonies with recombinant DNA and without recombinant DNA of plasmid.

Or

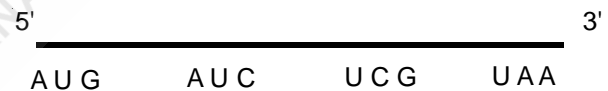
(B) Given below is a schematic representation of a mRNA strand



(i) In the above sequence identify the translational unit in mRNA.

(ii) Where are UTRs found and what is their significance ?

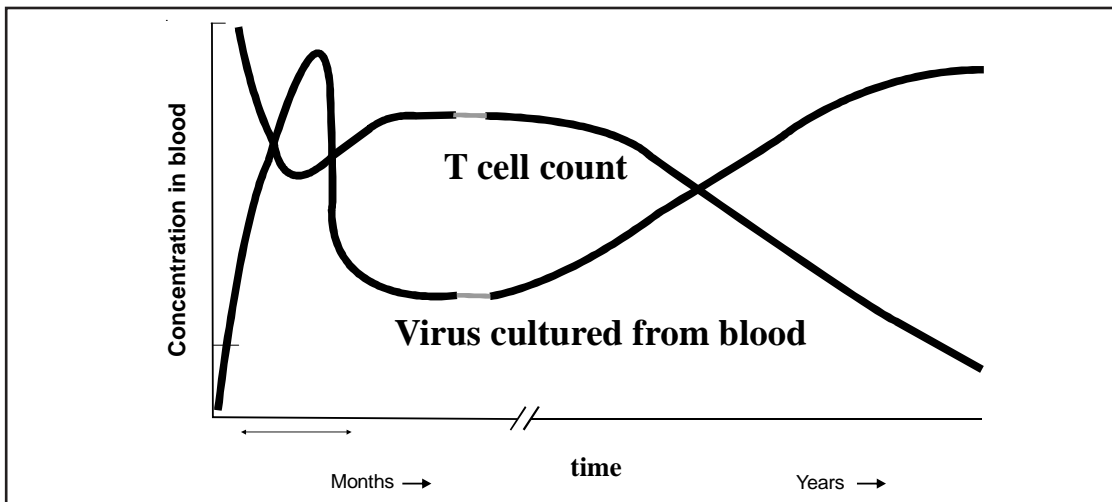
Ans. (i) Transcriptional unit of mRNA is :



A translational unit in mRNA is the sequence of RNA that is flanked by start codon AUG and stop codon UAA.

(ii) The UTR's are present at both 5' end before start codon and at 3' end after stop codon. They are required for efficient translation process.

Q. 19. Given below is the relationship between the HIV levels in the blood and helper T cell count in a person detected with AIDS. Study the relationship and answer the questions that follow.



(A) What kind of relationship is observed in the virus levels and the immune response after some days of the initial infection?

(B) Does it completely clear the virus from the body permanently? Give reason for your answer.

Ans. (A) HIV enters into T-lymphocytes and produce progeny viruses. The progeny viruses released in blood attach new T-lymphocytes. This is repeated and there is progressive decrease in number of T-lymphocytes.

(B) The HIV virus persists in the body and damage Immune system. Due to decrease in number of T-lymphocytes the person start suffering from infectious disease.

Q. 20. A culture plate of *Lactobacillus* shows blue-coloured colonies and colourless colonies. Explain the principle involved in the formation of such variance in the colour of colonies. 2

Ans. Blue-white screening is a rapid and efficient technique for the identification of recombinant bacteria. It relies the activity of β -galactosidase enzyme which cleaves lactose in to glucose and galactose. The inactivation of enzyme is referred to as insertional inactivation.

The presence of chromogenic substrate given blue coloured colonies of the plasmid does not have any new inert in the setup. Thus it help in identification of colonies with recombinant DNA and without recombinant DNA of plasmid.

Q. 21. Attempt either option A or B

(A) (i) It was estimated that if an evergreen forest has a GPP of $400 \text{ J/m}^2/\text{day}$ and $150 \text{ J/m}^2/\text{day}$ worth of carbon dioxide flows out of that forest, what is the NPP in that forest?

(ii) Explain why pyramids of energy must always be upright.

Ans. (A) (i) Gross Primary productivity (GPP) = $400 \text{ J/m}^2/\text{day}$
Respiration (Co^2) emission (R) = $150 \text{ J/m}^2/\text{day}$

Net Primary Productivity

$$\begin{aligned} \text{NPP} &= \text{GPP} - \text{R} \\ &= 400 - 150 = 250 \text{ J/m}^2/\text{day} \end{aligned}$$

(ii) **Pyramid of energy is always upright.** Energy at lower trophic level is always more than the higher level because energy flows from a particular trophic level to the next trophic level. Some energy is lost a heat at each step.

Or

(B) (i) Assume that, GPP Forest A = GPP Forest B = GPP Forest C, If Forest A has NPP = $1254 \text{ J/m}^2/\text{day}$; Forest B, NPP = $2157 \text{ J/m}^2/\text{day}$; and Forest C, NPP = $779 \text{ J/m}^2/\text{day}$, which one of these forests has maximum energy loss by respiration? Give reason.

(ii) Draw an ecological pyramid of number of the following food chains

a. Grass — Animal — Fleas on the host animal

b. Tree — Insects — Woodpecker

Ans. (B) (i) GPP of forest A = GPP of forest B

$$= \text{GPP of forest C}$$

$$\text{NPP of forest A} = 1254 \text{ J/m}^2/\text{day}$$

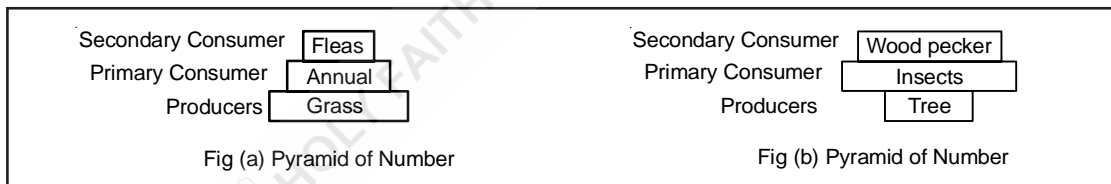
$$\text{NPP of forest B} = 2157 \text{ J/m}^2/\text{day}$$

$$\text{NPP of forest C} = 779$$

Forest C has maximum loss of energy

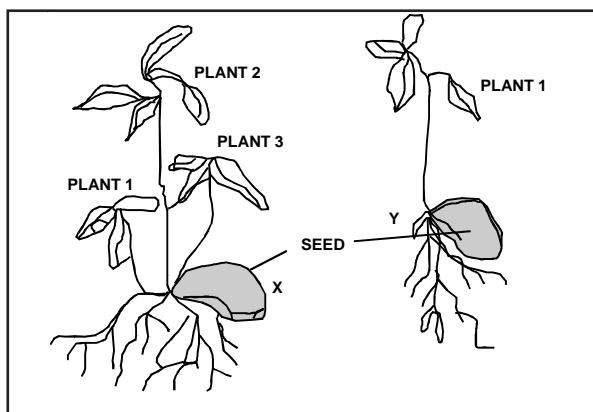
$$\text{GPP} - \text{R} = \text{NPP}$$

(ii)



SECTION—C

Q. 22. The image below shows two germinated seeds X and Y which belong to the same species. Seed X is produced by apomixis whereas seed Y is a product of sexual reproduction. 3



(A) Write the number of embryo(s), embryo sac(s) and ovules in the ovary of seed X.

(B) How multiples embryos are formed in citrus fruits?

(C) What advantage will plants developed from seed Y have over seed X?

Ans. (A) Each ovule contains three embryos and three embryosacs.

(B) Nucellus cells surrounding the embryo sac start dividing, protrude into embrosac and develop into embryo.

(C) The plants growing from seed X will have to share the resources/endosperm so there is a possibility of some plant being undernourished;/ only one plant in seed Y will use the entire endosperm for its growth or as the plants of seed X are clones they will not show variation and may succumb to environmental stress;/plants from seed Y will have genetic variation and so can show greater adaptability.

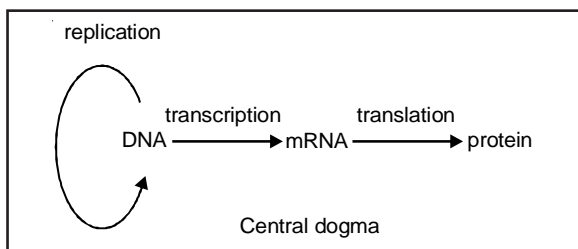
Q. 23. Name the place in human ovary where the first meiotic division is completed during oogenesis. What are the products of this division? Give the chromosome number of each type of cells involved in the process. 3

Ans. (i) Tertiary follicles of the ovary is the site where 1st meiotic division occur during oogenesis.

(ii) First meiotic division forms secondary oocyte and first polar body.

- (iii)** oogonia = 46 (2n)
 Primary oocyte = 46 (2n)
 Secondary oocyte = 23 (n)
 Ovum = 23 (n)
 Polar bodies = 23 (n)

Q. 24. The schematic representation given below shows the concept of Central Dogma. 3



(A) During the process of replication and transcription the pairing of nitrogenous bases is not similar. Explain.

(B) How is the above process modified in a retrovirus? Name the process.

(C) Justify why during the process of transcription only a segment of DNA is copied into RNA

Ans. (A) During replication, Adenine pairs with thymine in DNA; during transcription, adenine pairs with uracil in RNA.

(B) The nucleic acid is RNA in Retroviruses and it is used to synthesize DNA; the process is called reverse transcription.

(C) It is highly energy-rich process/or as per the need only the gene coding for a specific protein is transcribed

Q. 25. Describe the steps involved in Southern blot hybridization using radiolabeled VNTR as a probe. 3

- Ans. (i)** Isolation of DNA,
(ii) Digestion of DNA by restriction endonucleases,
(iii) Separation of DNA fragments by electrophoresis,
(iv) Transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon,
(v) Hybridisation using labelled VNTR probe, and
(vi) Detection of hybridised DNA fragments by autoradiography.

Q. 26. Bio-fertilisers are organisms that enrich the nutrient quality in the soil. Explain the role of three main sources of bio-fertilisers. 3

Ans. The main sources of biofertilizers are bacteria, fungi and cyanobacteria.

The nodules on the roots of leguminous plants are formed by the symbiotic association of Rhizobium. These bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as a nutrient. Other bacteria can fix atmospheric nitrogen while free-living in the soil (examples *Azospirillum* and *Azotobacter*), thus enriching the nitrogen content of the soil.

Fungi are also known to form symbiotic associations with plants (mycorrhiza). Many members of the genus *Glomus* form mycorrhiza. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought and an overall increase in plant growth and development.

Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environments many of which can fix atmospheric nitrogen, e.g. *Anabaena*, *Nostoc*, *Oscillatoria*, etc. In paddy fields, cyanobacteria serve as an important biofertiliser. Blue green algae also add organic matter to the soil and increase its fertility.

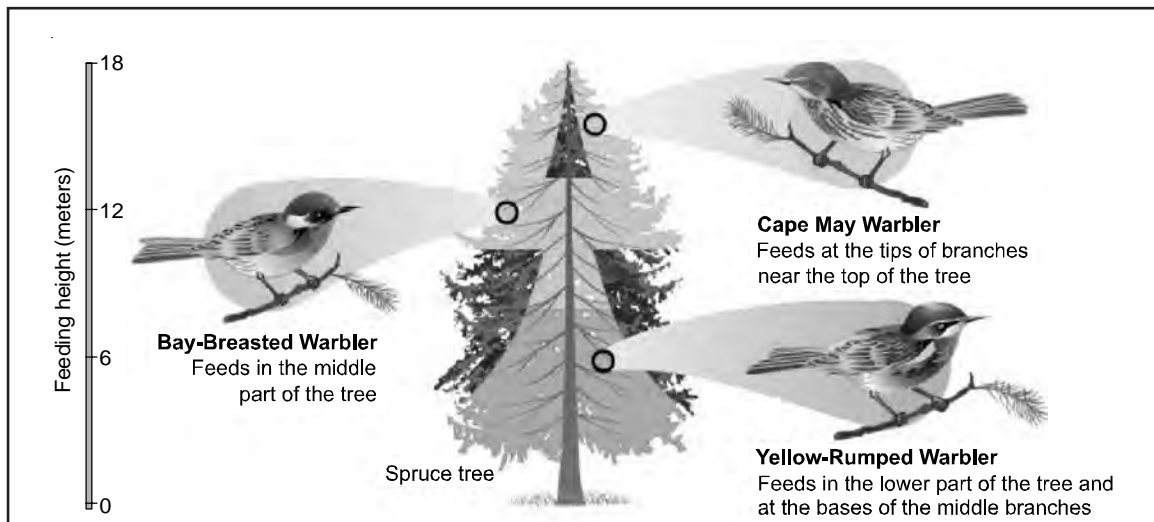
Q. 27. Explain how PCR technique can be used for amplification of a small amount of DNA template. 3

Ans. Polymerase Chain Reaction. In this reaction, multiple copies of the gene (or DNA) of interest are synthesised in vitro using two sets of primers (small chemically synthesised oligonucleotides that are complementary to the regions of DNA) and the enzyme DNA polymerase. The enzyme extends the primers using the nucleotides provided in the reaction and the genomic DNA as template.

If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times, i.e., 1 billion copies are made. Such repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a bacterium, *Thermus aquaticus*), which remains active during the high temperature induced denaturation of double stranded DNA. The amplified fragment if desired can now be used to ligate with a vector for further cloning.

Each cycle has three steps : (i) Denaturation, (ii) Annealing and (iii) Extensions.

Q. 28. (A) Diagram given below depicts different species of Warbler birds feeding on different regions on a Spruce tree. Explain the mechanism which helps them to co-exist. 3



Ans. (i) They are able to co-exist by mechanism of 'resource partitioning'

(ii) If two species compete for the same resource, they could avoid competition by choosing different foraging patterns.

(iii) MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities.

(B) What does Gause's exclusion principle state? Does it apply in the case shown above? Explain.

Ans. (i) Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely

(ii) and the competitively inferior one will be eliminated eventually.

(iii) No

SECTION—D

Q. 29 Assuming that within a population of beetles where Hardy Weinberg conditions are met, the colour black (B) is dominant over the colour red (b). 40% of all beetles are red (bb). 4

Given this information, answer the questions below:

(A) What is the frequency of red beetles? (1)

(B) Calculate is the percentage of beetles in the population that are heterozygous. (2)

Attempt either subpart C or D

(C) What is the frequency of homozygous dominant individuals? (1)

Ans. Allelic frequency can be calculated by using the Hardy-Weinberg model. The formula $p^2 + 2pq + q^2 = 1$. p is the frequency of dominant alleles and q of recessive allele

(A) 40% of all beetles are red (bb)

Frequency of red beetle bb = $0.4 \times 0.4 = 0.16$

(B) Frequency of heterozygous beetles = $0.6 \times 0.4 = 0.24$

(C) Frequency of homozygous black = $0.6 \times 0.6 = 0.36$

Or

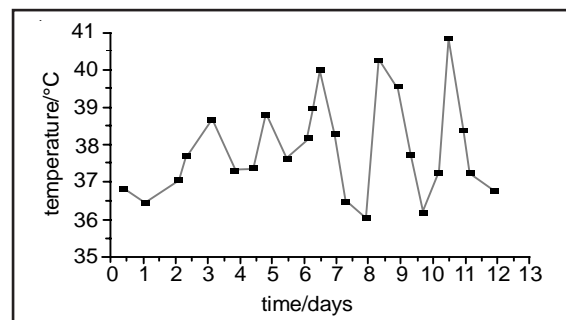
(D) Assuming that Hardy Wienberg conditions are met in the beetle population consisting of 1500 beetles. How many beetles would you expect to be black and red in colour respectively? (1)

Ans. 540 will be black BB

240 will be red bb

720 will be black Bb

Q. 30. Given below is the pattern of temperature in a person suffering from a non-viral disease transmitted by mosquitoes. Study the graph and answer the questions that follow : 4



(A) Explain the factor(s) responsible for this pattern of temperature. (1)

(B) How does this pathogen multiply in the human body? (2)

Attempt either subpart C or D

(C) How is this infection transmitted to humans? (1)

Ans. (A) Disease caused is Malaria. Periodic rise in temperature is due to rupture of RBCs, which release a toxic substance.

Haemozoin. It causes chills and bugs fever. This is cyclic completion of erythrocytic schizogony.

(B) Pathogen *Plasmodium* multiply by multiple fission (asexual reproduction) during *hepatic schizogony*, *erythrocytic schizogony* and *sporogony*.

(C) **Transmission of infection.** Infected female Anopheles mosquito bites and inject *sporozoites* in the body of healthy person.

Or

(D) Which stages of the life cycle of this pathogen are completed in the mosquito's gut ? (1)

Ans. Sexual phase of life cycle is completed in the gut of mosquito.

SECTION—E

Q. 31. Attempt either option A or B 5

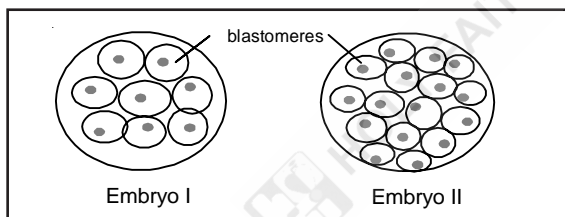
(A) Cryptorchidism is a condition in which the testes fail to descend into the scrotum. It can also lead to compromised Sertoli cell function and has an impact on Leydig cell function.

(i) Identify at least 3 parameters of male fertility which get affected due to cryptorchidism.

(ii) Which process will be affected if mature spermatids are not released from Sertoli cells?

(iii) Name and explain one assisted reproductive technology (ART process) in which the sperm/semen is used to assist fertilization.

(iv) Name and explain the assisted reproductive technology that should be used to complete the development of embryos I and II shown in the figure given below. 5



Ans. (A) (i) (a) Physical (b) Congenital (c) diseases and drug.

(ii) **Spermiation** : It is release of mature sperms from sertoli cell. Thus as sperms do not develop, spermiation is affect.

(iii) **ICSI** (Intra Cytoplasmic Sperm Injection)—It is the specialised procedure to form an embryo in the laboratory in which sperm is directly injected into the ovum. This technique is used in cases when male partener is unable to inseminate or the sperm count is low.

(iv) **Intrauterine Transfer (IUT)** : It is the transfer of embryo with eight blastomeres formed in-vitro fertilization to complete the further development embryos formed by in-vitro fertilization also could be used for transfer to assist those females who could not conceive

Or

(B) (i) Explain the significance of each of the following features present in plants given below:

(a) In rose-bay plant the stamens ripen before the stigma.

(b) In certain species of primrose, the flowers have short stamen and long style.

(c) The bisexual flower of mustard exhibits rejection of self-pollen grain.

(ii) Explain how autogamy is prevented in castor and papaya plant respectively.

Ans. (i) (a) The time of maturation of stamen and pistil in rose-bay plant is different the, pollen will not be able to germinate the stigma.

(b) Different position and incompatible placement of the reproductive structure prevent successful pollination and thus autogamy in primrose.

(c) Pollen pistil interaction for same species is not possible; this is a genetic mechanism which prevent the pollen grain from forming pollen tube on the pistil of the same flower.

(ii) In castor and papaya plant flowers are uni sexual so self-pollination is not possible. The plants are dioecious bearing male and female flowers on different plant (eg. papaya) or the plants may be **monecious** having male and female flowers on the same plant (e.g. castor).

Q. 32. Attempt either option A or B 5

(A) Explain how advent of biotechnology has helped in preventing infestation by nematodes and thereby increasing crop yield.

Ans. A Prevention of infestation of Tobacco plants by nematode.

Protection of tobacco plant against Nematode, *Meloidegyne incognita*.

(i) A nematode *Meloidegyne incognita* infects tobacco plants and reduces their yield.

(ii) The specific genes (in the form of cDNA) from the parasite are introduced into the plant using *Agrobacterium* as the vector.

(iii) The genes are introduced in such a way that both sense/coding RNA and antisense RNA (Complementary to the sense/coding RNA) are produced.

(iv) Since these two RNAs are complementary, they form a double-stranded RNA dsRNA.

(v) This initiated RNAi and thus, silenced the specific mRNA of the nematode.

(vi) As a result, the parasite cannot live in the transgenic host and the transgenic plant is protected from the pest.

Or

(B) In the future, genetic therapies may be used to prevent, treat, or cure certain inherited disorders in humans. Justify the statement with a suitable example.

Ans. **Gene Therapy.** It is defined as the introduction of a normal functional gene into cells which contain the defective allele of concerned gene with the objective of correcting a genetic disorder or an acquired disorder.

Treatment of ADA deficiency.

(i) Gene therapy was used to correct the genetic disorder called Severe Combined Immuno deficiency (SCID) syndrome produced by adenosine deaminase (ADA) deficiency.

(ii) In this, Normal ADA gene copies were produced by cloning.

(iii) Packed into retrovirus, most of the viral genes were replaced by ADA gene.

(iv) Lymphocytes were isolated from the patients.

(v) Recombinant DNA of the recombinant retroviruses were used to infect the lymphocytes.

(vi) The infected cells expressing the ADA gene were injected back into the patients.

(vii) The normal ADA gene was then expressed in the patients and ADA deficiency is partially corrected. If the gene isolated from bone marrow cells producing ADA is introduced into embryonic cells at early stages, it could provide permanent cure.

Q. 33. Attempt either option A or B **5**

(A) (i) Why is there a need to conserve biodiversity? (Any two reasons)

(ii) Name and explain any two causes that are responsible for the loss of biodiversity.

Ans. (A) (i) Need to Conserve Biodiversity : There are several utilitarian arguments that can be used to justify the statement that “biodiversity plays a major role in many ecosystem services that nature provides.” Two broadly utilitarian arguments are:

(a) Biodiversity plays a major role in many ecosystem services that nature provides. The Amazonian rain forest is estimated to produce, through photosynthesis, 20 per cent of the total oxygen in the earth’s atmosphere.

(b) Pollination is a method without which plants cannot give us fruits or seeds is another service, ecosystems provide through pollinators like – bees, bumblebees, birds and bats.

Therefore, conserving biodiversity is important for maintaining the resilience and adaptability of ecosystems and the species that depend on them.

(c) One ethical reason for conserving biodiversity is that every species has an inherent right to exist, and humans have a moral responsibility to protect and preserve the natural world for future generations. Biodiversity provides important ecological, economic, and cultural benefits that sustain human well-being and quality of life, and it is our ethical obligation to prevent the extinction of species and the destruction of ecosystems.

(ii) Causes for loss of biodiversity

(a) When a large habitat is broken into small fragments due to various activities, mammals and birds requiring large

territories and certain animals with migratory habitats are badly affected, leading to population decline.

(b) Nile perch introduced in Lake Victoria eventually led to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish.

- Parthenium/Lantana/water hyacinth caused environmental damage and threat to our native species

- African catfish-*Clarias gariepinus* introduced for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers.

(c) Yes; Humans have overexploited natural resources for their ‘greed’ rather than ‘need’ leading to extinction of these animals.

Or

(B) (i) Name the two types of desirable approaches to conserve biodiversity? Explain with examples bringing out the difference between the two types.

(ii) State the features of a stable biological community ?

Ans. (i) Approaches to conserve biodiversity

(a) In-situ conservation : It is the conservation of species in their natural habitat.

Hot-spots : These are the areas rich in species have high endemism. They are eastern Himalaya Hot-spots, western Ghats hotspots and Andaman Nicobar hotspots.

(b) Protected areas : They are (i) sacred forests, sacred lakes.

(ii) Biosphere reserves and (iii) National Reserve wildlife sanctuaries.

Ex-situ conservation. It means maintenance of off-site collections either in gardens by farmers, botanical garden or storing seeds, genes, pollen, tissue culture etc.

The rare plants have been found to flourish in large numbers under the care and protection of gardeners and nature lovers.

The farmers have been maintaining genetic diversity (enormous varieties) of crop plants since ancient times by saving seeds or other components for the next plantings.

Collection of samples of cultivated and wild varieties of plants and storing them in botanical gardens is another method of conservation of germplasm.

In seeds, the living material remains in metabolically suspended state. When the seeds are to be stored for longer periods, it is necessary to avoid conditions which favour respiration and enzymatic action.

Mass extinction. Complete removal of species or wiping out of entire families from the face of the earth is called mass extinction. Mass extinction is generally due to changing climatic conditions.

An example of mass extinction is the complete disappearance of dinosaurs at the end of cretaceous period.

India's effort in biodiversity conservation. India has greatly contributed to conservation of biodiversity owing to its great utility and need for conservation. The following measures have been taken for this purpose :

1. Setting up of bodies like Indian Board for Wildlife, Bombay Natural History Society etc.

2. Observation of first week of October as national wildlife week.

3. Introduction of Wildlife Protection Act in 1972.

4. Setting up of sanctuaries, national parks and biosphere reserves.

Differences between in-situ and Ex-situ conservation

In-situ Conservation	Ex-situ Conservation
1. It is the conservation of endangered species in their natural habitat. 2. Protection from predators is ensured. 3. The population recovers in natural habitat. 4. The depleting resources are augmented.	1. It is the conservation of endangered species outside their natural habitat. 2. Protection from all adverse factors is ensured. 3. Offsprings produced in captive breeding are released in natural habitat for acclimatization. 4. They are kept under human supervision and provided all the essentials.

(ii) Features of stable biological community :

(a) Communities should have greater biodiversity for greater stability.

(b) It should be able to prevent invasion by alien species.

(c) It should be able to restore itself in a short period of time.

(d) Variations should be minimal to the community.

Holy Faith New Style Sample Paper–1 (Solved)

(Based on the Latest Design & Syllabus Issued by CBSE)

CLASS — 12th BIOLOGY (THEORY)

Time Allowed : 3 Hours]

[Maximum Marks : 70

General Instructions :

- All questions are compulsory.
- The question paper has five sections and 33 questions.
- 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.
- 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.
- Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION—A

Q. No. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

1. Remnants of nucellus are persistent during seed development in : 1

- (a) pea (b) groundnut
(c) wheat (d) black pepper

Ans. (d)

2. The wall layer of microsporangium which nourishes the pollen grain is : 1

- (a) epidermis (b) endothecium
(c) middle layers (d) tapetum

Ans. (d)

3. A short piece of DNA, having 20 base pairs, was analysed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown in the table.

Number of nucleotide bases				
	Adenine	Cytosine	Guanine	Thymine
Strand 1	4	4		
Strand 2		5		

How many nucleotides containing adenine were present in strand ?

- (a) 2 (b) 5 (c) 5 (d) 7

Ans. (d)

4. In a certain species of insects, some have 13 chromosomes, and the others have 14 chromosomes. The 13 and 14 chromosome bearing organisms are : 1

- (a) males and females, respectively
(b) females and males, respectively
(c) all males
(d) all females

Ans. (d)

5. At a particular locus, the frequency of allele A is 0.8 and that of allele a is 0.2. What would be the frequency of heterozygotes in a random mating population at equilibrium ? 1

- (a) 0.32 (b) 0.16
(c) 0.24 (d) 0.48

Ans. (a)

6. Variations caused due to mutations are : 1

- (a) random and directionless
(b) random and directional
(c) random and small
(d) random, small and directional

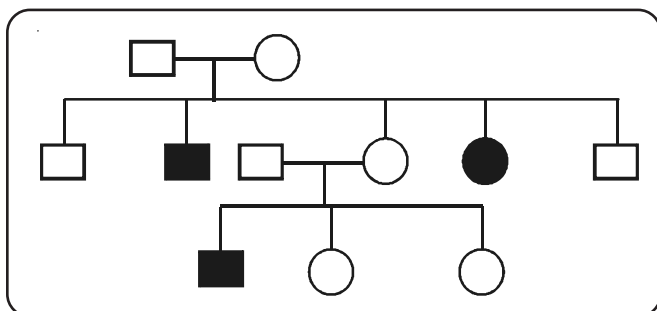
Ans. (a)

7. What is the smallest part of a DNA molecule that can be changed by a point mutation ? 1

- (a) Oligonucleotide
 (b) Codon
 (c) Gene
 (d) Nucleotide

Ans. (d)

8. What should be the genotype of the indicated member ? 1



- (a) AA (b) Aa
 (c) XY (d) aa

Ans. (d)

9. At a particular locus, the frequency of allele A is 0.8 and that of allele a is 0.2. What would be the frequency of heterozygotes in a random mating population at equilibrium ? 1

- (a) 0.32 (b) 0.16
 (c) 0.24 (d) 0.48

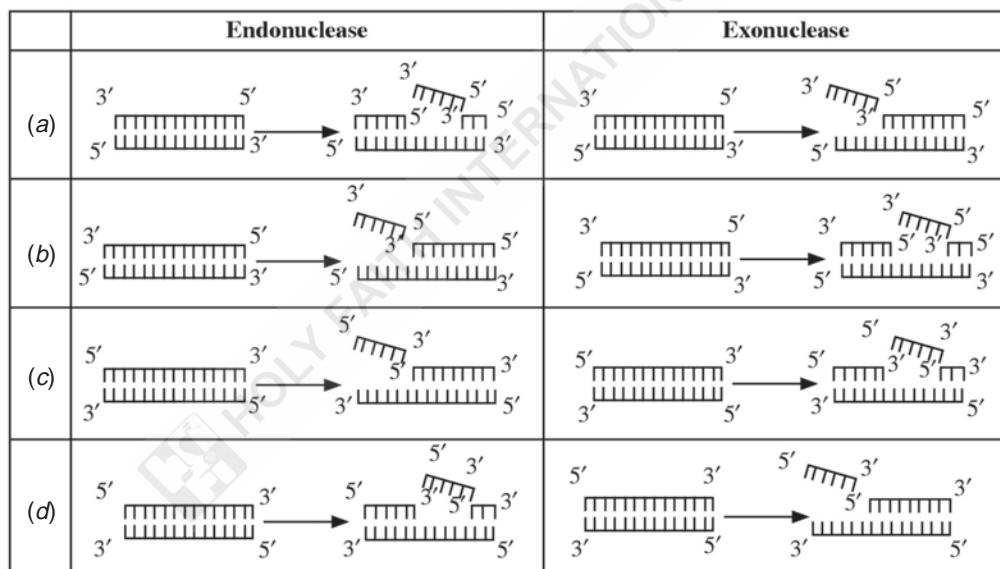
Ans. (a)

10. Which of the following statements indicates parallelism in genes and chromosomes ? 1

- (i) They occur in pairs
 (ii) They segregate during gamete formation
 (iii) They show linkage
 (iv) Independent pairs segregate independently
- (a) (i) and (iii)
 (b) (ii) and (iii)
 (c) (i), (ii) and (iii)
 (d) (i), (ii) and (iv)

Ans. (d)

11. Identify the activity of endonuclease and exonuclease in the given image. 1



Ans. (d)

12. Which of the following water samples in the table given below will have a higher concentration of organic matter ? 1

Water Sample	Level of pollution	Value of BOD
(a)	High	High
(b)	Low	Low
(c)	Low	High
(d)	High	Low

Q. 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.

Ans. (a)

13. Assertion (A) : Ribosomal RNA is synthesised in the nucleus of the cell. 1

Reason (R) : It is translated with the enzyme RNA polymerase III.

Ans. (b)

14. **Assertion (A)** : Primary endosperm nucleus is diploid.
Reason (R) : It is the product of double fertilisation. 1
Ans. (a)
15. **Assertion (A)** : Smoking can raise blood pressure and increase heart rate. 1
Reason (R) : Nicotine stimulates adrenal glands to release adrenaline and nor-adrenaline into the blood circulation, both of which raise blood pressure and increase heart rate.
Ans. (a)
16. **Assertion (A)** : PCR is a powerful technique to identify genetic disorders. 1
Reason (R) : PCR can detect mutations in low amounts of DNA.
Ans. (a)

SECTION—B

Attempt either option A or B

17. **(A) Explain the process of hormonal regulation of spermatogenesis.** 2

Ans. During the puberty in males, the hypothalamus significantly increases the secretion of gonadotropin releasing hormone (GnRH).

The GnRH then stimulates the anterior pituitary to secrete two gonadotropins – luteinising hormone (LH) and follicle stimulating hormone (FSH).

The LH acts on the leydig cells present in between the seminiferous tubules of the male gonads to stimulate the synthesis and secretion of testosterone. The testosterone initiates the process of spermatogenesis.

The FSH acts on the sertolli cells also present in the seminiferous tubules of the male gonads to secrete the factors required by germ cells as they mature into spermatozoa.

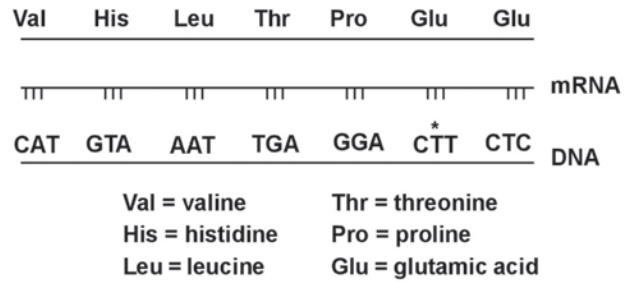
Or

- (B) Explain the significance of fertilisation**

Ans. Significance of fertilisation

- (i) The fusion of male and female pronuclei in fertilisation restores the diploid number of chromosomes.
- (ii) The activation of secondary oocyte undergoes maturation to form ovum.
- (iii) Fertilisation initiates cleavage or segmentation.
- (iv) The combination of the chromatin material from two different parents forms the physical basis of biparental inheritance and variation.

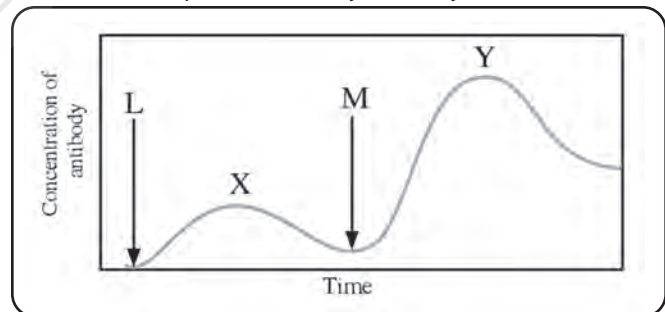
18. **(A) The diagram below shows the sequence of amino acids in part of a haemoglobin molecule.**



- (a) If the base T* was with A, how would it affect the haemoglobin chain?
 (b) Name the condition and the effects associated with the above substitution.

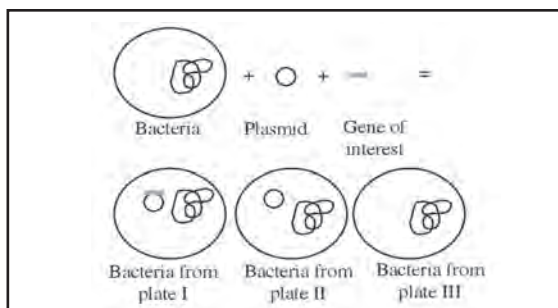
Ans. (a) CTT upon substitution will become CAT and glutamic acid will be substituted by valine in the given position.
 (b) It leads to a condition of sickle cell anaemia, caused due to the substitution of glutamic acid at residue 6 in b-globin with valine (b6 Glu @ Val). Mutant haemoglobin undergoes polymerisation and changes the biconcave shape of RBC to an elongated sickle shape, hence reducing its oxygen carrying capacity.

19. The graph given below indicates the administration of the first (L) and second doses (M) of a vaccine. The corresponding response of the body is indicated by X and Y. Interpret the graph and explain the reason for such a response shown by the body. 2



Ans. When the first dose of the vaccine (L) is administered, the body's immune system encounters the antigenic protein of the weakened or inactivated pathogen for the first time, resulting in a low-intensity response (X). This initial encounter is known as the primary immune response. However, during the second dose (M) when the body encounters the same antigenic protein again, it triggers a highly intensified secondary response (Y). This is due to the immune system's memory of the initial antigen exposure, resulting in a faster and stronger immune response. As a result, the secondary immune response is more effective in eliminating the pathogen compared to the primary immune response.

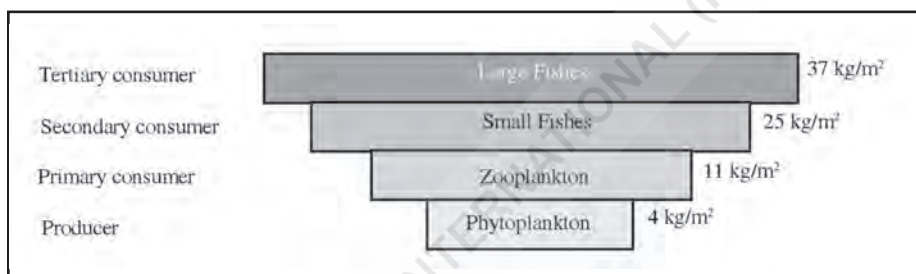
20. The image shows the result of plating bacteria in chromogenic medium after incorporating the gene of interest in plasmid. Some plates had blue colonies; some plates had white colonies. A single bacterium extracted from plates I, II, III is shown Fig. 2



- (a) Identify the plate(s) which is/are white. Give a reason.
 (b) Identify the plate(s) which is/are blue. Give a reason.

Ans. (a) The bacteria from plate I will produce white colonies. The plasmid comprises the β -galactosidase gene that

Ans. It is an inverted pyramid of biomass.



Inverted pyramid of biomass

Or

- (B) Name the hormone composition of oral contraceptive used by human female. Explain how does it act as contraceptive.

Ans. (i) Progestogen or progestogen-estrogen combination is used as oral contraceptive by human females.

- (ii) These pills inhibit ovulation as well as implantation. They also alter the quality of cervical mucus to prevent or retard entry of sperms.

SECTION—C

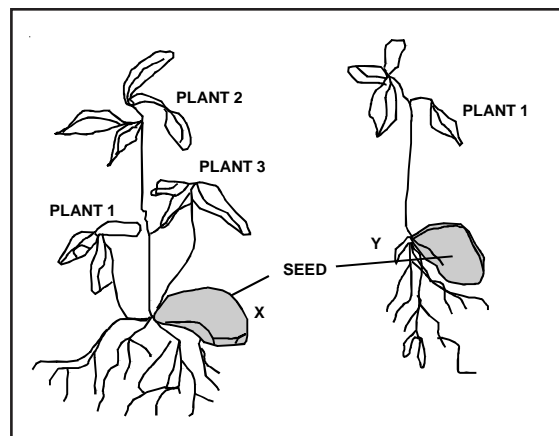
22. The image below shows two germinated seeds X and Y which belong to the same species. Seed X is produced by apomixis whereas seed Y is a product of sexual reproduction.

3

produces blue colonies in the chromogenic medium containing IPTG and X-gal. However, the gene has been insertionally deactivated by the insert and transformed in the host *E. coli*. Thus *E. coli* will produce white colonies in the chromogenic medium.

- (b) The bacteria from the second plate lacks the insert in the plasmid. Hence bacteria carrying the β -galactosidase (in the plasmid) gene will produce blue colonies in the chromogenic medium.

21. (A) Biomass of a standing crop of phytoplankton is 4 kg/m^2 which supports a large standing crop of zooplankton having a biomass 11 kg/m^2 . This is consumed by small fishes having biomass 25 kg/m^2 which are then consumed by large fishes with the biomass 37 kg/m^2 . Draw an ecological pyramid indicating the biomass at each stage and also name the trophic levels. Mention whether it is an upright or inverted pyramid. 2



- (A) Write the number of embryo(s), embryo sac(s) and ovules in the ovary of seed X.
 (B) How multiples embryos are formed in citrus fruits?
 (C) What advantage will plants developed from seed Y have over seed X ?

Ans. (A) Each ovule contains three embryos and three embryosacs.

(B) Nucellus cells surrounding the embryo sac start dividing, protrude into embryosac and develop into embryo.

(C) The plants growing from seed X will have to share the resources/endosperm so there is a possibility of some plant being undernourished;/ only one plant in seed Y will use the entire endosperm for its growth or as the plants of seed X are clones they will not show variation and may succumb to environmental stress;/plants from seed Y will have genetic variation and so can show greater adaptability.

23. Explain the phases in embryonic development from the morulla stage till the establishment of Pregnancy in a human female. 3

Ans. The zygote after fertilization undergoes several cell divisions to form a solid ball of cells called a morula (8–16 blastomeres cell stage). Further stages are as follows: The morula undergoes further division and transforms into a blastocyst as it travels into the uterus. The blastocyst is composed of blastomeres arranged into two distinct layers: the outer layer called the trophoblast and the inner group of cells attached to the trophoblast known as the inner cell mass. Subsequently, the trophoblast attaches to the endometrium while the inner cell mass undergoes differentiation to develop into the embryo. After attachment, the cells in the uterus divide rapidly and cover the blastocyst. This process leads to the implantation of the blastocyst into the endometrium of the uterus. This event is known as implantation, which marks the beginning of pregnancy.

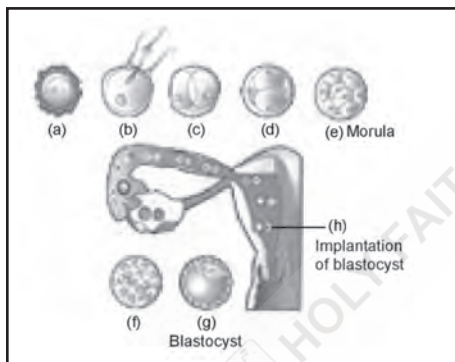


Fig. Fertilisation and passage of growing embryo through fallopian

24. A pregnant human female was advised to undergo MTP (Medical Termination of Pregnancy). It was diagnosed that the fetus she was carrying had developed from a zygote having 45 chromosomes with only one X chromosome. 3

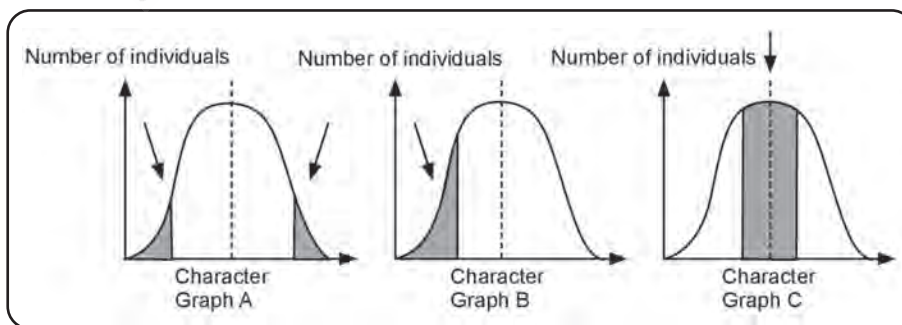
- (a) What is this condition called and how does it arise?
- (b) Why was she advised to undergo MTP (Medical Termination of Pregnancy) ?

Ans. (a) The foetus has a condition of Turner syndrome due to aneuploidy of the sex chromosome. The lack of one chromosome gives rise to the genotype 44 + XO.

- (b) She was advised to undergo MTP because the baby will have the following abnormalities:
 - rudimentary ovaries
 - underdeveloped breasts
 - absence of other secondary sexual characters
 - delayed or absence of menstrual cycle and sterility.

25. The graphs below show three types of natural selection. The shaded areas marked with arrows show the individuals in the population which are not selected. The dotted vertical lines show the statistical means. 3

- (a) What names are given to the types of selection shown in Graphs A, B and C?
- (b) After the selection has operated for several generations in the above populations indicated as graphs A, B and C, graphically illustrate the probable results.

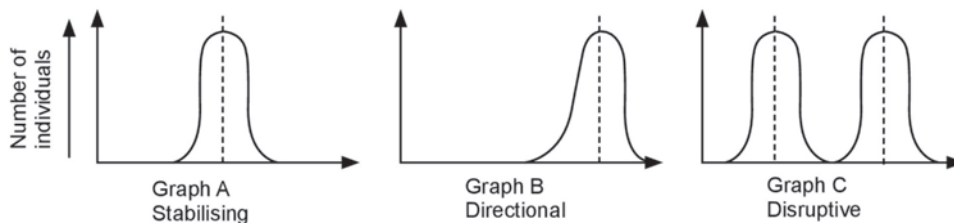


Ans. (a) A – stabilising; B – directional; C – disruptive;
 (b) Stabilising selection (Graph A) occurs when selective pressures favour the intermediate traits of a population, leading to a reduction in the extremes of the trait distribution.

Directional selection (Graph B) happens when selective pressures favour one extreme of a trait, causing a shift in the population's trait distribution towards that favoured extreme.
 Disruptive selection (Graph C) takes place when selective

pressures favour individuals at both extremes of a trait,

leading to the formation of two distinct peaks in the trait distribution.



26. The aeration tank of a sewage treatment plant is not functioning properly. Explain in detail the impact of this on the treatment of sewage and BOD of the effluent. 3

Ans. The malfunctioning of the aeration tank in the secondary treatment or biological treatment of sewage can have detrimental effects on the treatment process. When the air is not pumped into the tank, it inhibits the growth of beneficial aerobic microbes that are essential for the formation of flocs. These flocs, consisting of bacteria associated with fungal filaments, create mesh-like structures that aid in the breakdown of organic matter.

As a result, a significant amount of the organic matter present in the sewage effluent will not be efficiently consumed by these bacteria. This leads to inadequate reduction of the biochemical oxygen demand (BOD) in the effluent. BOD measures the amount of oxygen required for the oxidation of organic matter by bacteria in one litre of water. A high BOD level in wastewater indicates a greater pollution potential. Consequently, if the aeration tank is not functioning properly, the effluent will remain polluted with a high concentration of organic matter and a high BOD level.

27. A farmer grew 2 varieties of corn crops in fields A and B. He grew normal corn crops in field A and GM corn crops in field B. He observed corn borers attacked only in field A. To control it, spores of Bt were sprayed in field A.

- Name the gene in the spores responsible for the control of this pest.
- What effect will the spores of Bt have on the insect pest?
- How has field B developed resistance against this pest?

Ans. (a) *CryIAb*

- The spores containing Bt gene can produce the inactive

crystalline toxin. It activates under alkaline pH in the insect gut that breaks the lining of the gut epithelial cells causing pores, swelling and cell lysis.

- Field B is constituted of GM corn crops containing the *CryIAb* gene inserted (using rDNA technology) that produces the Bt-toxin that is fatal for the corn borer. Hence the GM corn is resistant against the pest.

28. (A) Give three reasons as to why the prokaryotes are not given any figures for their diversity by the ecologists. 3

Ans. The prokaryotes cannot be given any figures for their diversity because of the reasons below:

- Based on the available methods of classification, the vast diversity of microbes is very tedious to identify and classify accordingly.
- Many microbes cannot be cultured and maintained in vitro conditions.
- The biochemical and molecular characteristics indicate varied diversity and demand further advancement in these techniques to evidently classify the varied microbial community.

(B) Lipoprotein lipase deficiency (LPLD) is a genetic disorder in which a person has a defective gene for lipase. This leads to high triglycerides, stomach pain and fat deposits under the skin. It may eventually affect the liver, pancreas and may also cause diabetes. The disorder occurs if a child acquires defective genes from both parents (autosomal recessive). ERT (enzyme replacement treatment) is one of the treatments offered to patients with LPLD.

- (i) What procedure is followed in ERT?
(ii) What could be one possible drawback of ERT?
- How can LPLD be treated using biotechnology? Elaborate.

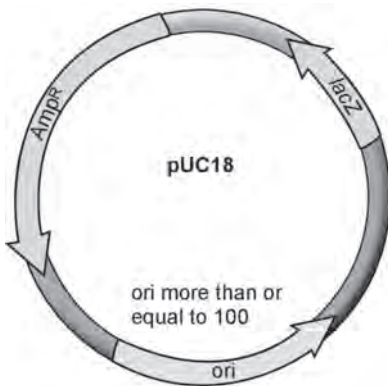
Ans. (a) (i) ERT (Enzyme Replacement Therapy) is a method of intravenous (IV) infusions to correct the underlying enzyme deficiency, hence the functional lipase enzyme is injected into the patient.

(ii) ERT is a temporary process and does not give a complete cure.

- (b) The disease can be cured using the method of gene therapy. The patients' cells are transformed with the corrected (functional lipoprotein enzyme) gene insert. The cDNA of the normal gene is introduced into the lymphocytes of the patients using the retroviral vector. This will replace the defective gene and hence produce functional lipoprotein lipase enzyme. This will overcome the deficiency.

SECTION—D

29. The structure below shows pUC18 which is similar to pBR322 in its function. However, they differ in some of their restriction sites and number of ori. The ori number for pBR322 is approximately 20. **4**



- (a) How are pUC18 and pBR322 used in biotechnological studies?
- (b) The *lac Z* gene has many recognition sites. Study the segment of DNA given below and answer the questions.
 5'... ATC GTA AAG CTT CAT...3'
 3'... TAG CAT TTC GAA GTA...5'
- (i) Applying your knowledge of palindrome sequences, identify and mark the possible region where the restriction enzyme X will act.
- (ii) Restriction enzyme Y was used to extract gene of interest from a plant. This gene needs to be inserted in the given DNA segment which has been treated with restriction enzyme X. Will there be a successful recombination? Explain with a reason.
- (c) Which one of the two (pUC18 and pBR322) would you prefer for biotechnological studies? Justify.
- Or**
- (d) What will be the impact if *ori* in the above structure gets damaged?

Ans. (a) Both pUC18 and pBR322 are used as cloning vectors. They can be used as a transfer vehicle for inserting the

gene of interest isolated from the desirable organism into the host.

OR

A damaged ori will inhibit replication and not produce copies of the plasmid.

- (b) (i) The sequence that reads the same in both the strands in the 5' to 3' direction
 5'... AAG CTT ...3'
 3'... TTC GAA ...5'
- (ii) The restriction enzyme used to extract the gene should be the same one used for restricting the host DNA segment for the ligation of the 2 parts. Some restriction enzymes produce sticky ends with overhangs that help in easy ligation of the insert and plasmid.
- (c) pUC18 is preferred as it has higher copy number. pUC18 carries the ampicillin resistance gene, providing a selectable marker for bacteria that have successfully taken up the plasmid.

30. Unlike animals, plants cannot flee in order to defend themselves, therefore, they have evolved an astonishing variety of morphological and chemical defence against herbivores. Thorns are the most common morphological means of defence. Many plants produce or store chemicals that make the herbivore sick when they are consumed, inhibit feeding or digestion, disrupts its reproduction or even kill it. Some plants produce highly poisonous chemicals and that is why no cattle or goat browse on those plants. A wide variety of chemical substances that we extract from plants on a commercial scale are produced by them actually as defence against grazers and browsers. **4**

- (a) Why do you never see cattle or goat browsing on weed Calotropis ?
- (b) What could be the possible reason for the invasive growth of the prickly pear cactus introduced in Australia ?
- (c) Who is most likely to get sick by consuming chemicals produced by plants ?

Or

- (d) Against what do plants develop morphological and chemical defences ?

Ans. (a) The Calotropis plant produces highly poisonous cardiac glycoside that is why we never see any cattle or goats browsing on this plant.

(b) The reason for the invasive growth of the prickly pear cactus introduced in Australia is the absence of its natural predator.

- (c) Grazers and browsers
OR
Herbivores or predators

SECTION—E

31. (A) Placed below are case studies of some couples who

were not able to have kids. These couples are not ready for adoption or taking gametes from donors. After thoroughly examining the cases, which Assisted Reproductive Technology will you suggest to these couples as a medical expert? Explain briefly with justification of each case. 5

Couple	Test reports of female partner	Test reports of male partner
Couple 1	Normal reports	Normal sperms in testes, missing connection in epididymis and vas deferens
Couple 2	Blockage in the fallopian tube	Normal reports
Couple 3	Normal reports	Poor semen parameters in terms of count, motility and morphology
Couple 4	Low ovarian reserve	Normal reports
Couple 5	Sterilisation in female	Morphologically abnormal sperms

Ans. Couple 1 : Normal reports of female, normal sperms in testes, missing connection in epididymis and vas deferens in male

Assisted Reproductive Technology: In cases where there is a missing connection between the epididymis and vas deferens in males, one possible assisted reproductive technology that can be considered is intrauterine insemination (IUI) with donor sperm.

IUI involves the placement of specially prepared sperm directly into the woman's uterus, bypassing the need for natural sperm transport through the missing connection. In this case, donor sperm from a healthy male with normal sperm parameters would be used for the insemination process.

Couple 2 : Blockage in the fallopian tube in the female, normal reports of male

Assisted Reproductive Technology: Since the female has blocked fallopian tube, it will not allow the sperm to reach the site of fertilisation. Therefore, in-vitro fertilisation (IVF) followed by IUT (test-tube baby) would involve the transfer of embryo with more than 8 cell blastomeres in uterus.

Couple 3 : Normal reports of female, poor semen parameters in terms of count, motility and morphology in male partner

Assisted Reproductive Technology: The couple may be suggested intracytoplasmic sperm injection (ICSI) in which sperm is directly injected into the ovum. This process of artificial insemination is used when the sperms have poor characteristic or low sperm count.

Couple 4: Low ovarian reserve in female, normal reports of male

Assisted Reproductive Technology: The couple may be suggested for In-vitro-fertilization (IVF) by selection of normal blastocysts from ovary followed by ZIFT for transferring the zygote or early embryos up to 8 cell blastomeres stage or transfer of embryo with more than 8 cell blastomere stage into the uterus (IUT).

Couple 5: Sterilisation in male, morphologically abnormal sperms in male partner

Assisted Reproductive Technology: The couple may be suggested artificial insemination (AI) technique. The sperm from the male and the egg from the female can be fused in vitro (IVF) and the zygote formed can be implanted into the female uterus through IUT intra uterine transfer.

Or

Given below are certain situations. Analyse the situation and suggest the name of suitable contraceptive device along with mode of action.

Situation	Requirement of contraceptive	Name of the contraceptive device	Mode of action
1.	Blocking the entry of sperms through cervix		
2.	Spacing between children		
3.	Effective emergency contraceptive		
4.	Terminal method to prevent any more pregnancy in female		
5.	Sterilisation in male		

Ans.

Situation	Requirement of contraceptive	Name of the contraceptive device	Mode of action
1.	Blocking the entry of sperms through cervix	Diaphragms/cervical caps/vaults	Cover the cervix during coitus
2.	Spacing between children	Cu or hormone releasing IUDs such as CuT/Cu7/ Multiload 375/ Progestasert/LNG 20	Cu ions from Cu containing IUDs increase phagocytosis of sperms within uterus, suppress sperm motility and fertilising capacity/ hormone releasing IUDs make uterus unsuitable for implantation
3.	Effective emergency contraceptive	Pills containing Progestogens or progestogen-estrogen combination or IUDs within 72 hours of coitus	Pills inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent the entry of sperms/IUDs – Cu ions increase phagocytosis of sperms within uterus, suppress sperm motility and fertilising capacity/hormone releasing IUDs make uterus unsuitable for implantation
4.	Terminal method to prevent any more pregnancy in female	Tubectomy	Block gamete transport and prevent conception
5.	Sterilisation in male	Vasectomy	Blocks sperm transport

Attempt either option A or B

32. (A) (i) Describe the structure of a 'transcription Unit'.
 (iii) Explain the basis of defining the two DNA strands of a structural gene in a transcription unit. 5

Ans. (a) Structure of transcription units

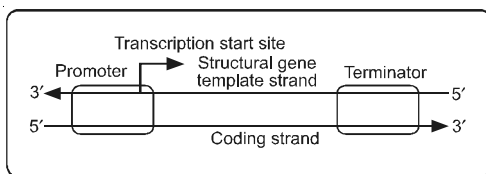


Fig. Schematic structure of a transcription units

Promoter and Terminator are present on the sides of structural gene in a transcription unit. Promoter is located on the 5'-end of the unit and terminator on the 3'-end of (downstream) of the coding strand. It determines the end of the process of transcription unit.

- (b) Two strands of DNA in the structural gene of a transcription unit is called a template strand as well as coding strand.

The strand that has the polarity of 3' 5' acts as a template and is referred to the template strand. The other strand which has the polarity of (5' → 3') is referred to a coding strand. The RNA polymerase binds to the promoter region and adds nucleotide to the 3' end of the growing RNA molecule.

Or

- (B) In short horn cattle, the coat colours red or white are controlled by a single pair of alleles. A calf which receives the allele for red coat from its mother and the allele for white coat from its father is called a 'roan'. It has an equal number of red and white hairs in its coat.

- (a) Is this an example of codominance or of incomplete dominance?

(b) Give a reason for your answer.

(c) With the help of genetic cross, explain what will be the consequent phenotype of the calf when

(i) red is dominant over white.

(ii) red is incompletely dominant.

Ans. (a) Codominance

(b) Both the alleles are expressed and there is no masking effect of any of the 2 alleles received from the male and female parents.

(c) (i) Pure breeding red coated cattles – 'RR' (dominant)
Pure breeding white coated cattles – 'rr' (recessive)
The cross between 'RR' and 'rr' would produce red coated cattles (Rr).

	RR × rr	
	R	R
r	Rr	Rr
r	Rr	Rr

Rr will indicate red phenotype in the F_1 generation.

(ii) If the red coat is incompletely dominant over the white coated cattles, then F_1 may produce pink coat on crossing them. In this phenomenon, the dominant allele red is not completely masking the white colour coat due to which they produce pink coloured coat upon crossing. If pure breeding red coated cattles are represented as 'RR' and pure breeding white coated as 'rr', then the pink coated cattles are 'Rr'.

	R	R
r	Rr	Rr
r	Rr	Rr

Rr will indicate pink phenotype in the F_1 generation.

33. (A) Explain the role of primary and secondary lymphoid organs with the help of suitable examples.

5

Ans. The production, maturation and proliferation of the lymphocyte occur in the lymphoid organs.

The bone marrow and the thymus are the primary lymphoid organs, a site of differentiating the immature lymphocytes.

Following maturation, they migrate to the secondary lymphoid organs (spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix). It is a site of

interaction with the antigen, where they proliferate as effector cells.

The primary lymphoid organ such as the bone marrow, is where all blood cells, including lymphocytes, are made. The thymus is a lobed organ that is situated below the breastbone and close to the heart. The thymus and bone marrow both offer T-lymphocytes micro-environments for growth and maturation. The spleen is a large organ with a bean-like structure. By capturing blood-borne microorganisms, it serves as a filter for the blood and is primarily composed of lymphocytes and phagocytes. There is a sizable erythrocyte reserve in the spleen as well.

Small, solid structures known as lymph nodes are scattered throughout the lymphatic system. Microorganisms or other antigens that accidentally enter the lymph and tissue fluid are captured by lymph nodes. The immunological response is brought on by antigens that become lodged in the lymph nodes and activate the lymphocytes there.

Mucosa-associated lymphoid tissue (MALT), a kind of lymphoid tissue, is found within the lining of the three main tracts (respiratory, digestive and urogenital). About 50% of the lymphoid tissue in the human body is made up of it.

Or

(B) Name the cells HIV (Human Immuno Deficiency Virus) gains entry into after infecting the human body. Explain the events that occur in these cells.

Ans. Action of HIV in the body.

- After getting into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase.
- This viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce virus particles. The macrophages continue to produce virus and in this way acts like an HIV factory.
- Simultaneously, HIV enters into helper (T_H) T-lymphocytes replicates and produces progeny viruses. The progeny viruses released in blood attack other helper T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person.
- During this period, the person suffers from bouts of fever, diarrhoea and weight loss. Due to decrease in the number of helper T-lymphocytes, the person starts

suffering from infection due to bacteria such as *Mycobacterium*, viruses, fungi and even parasite *Toxoplasma*. The patient becomes immuno-deficient and unable to fight against such infections.

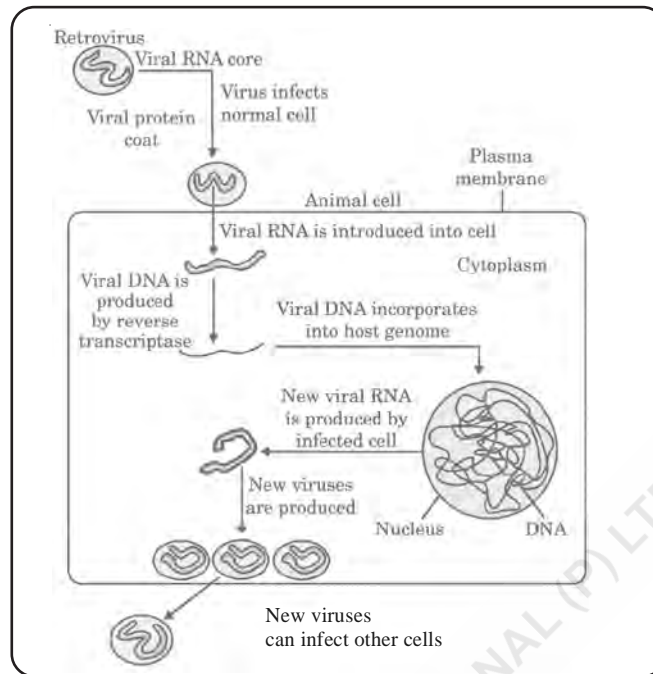


Fig. Action of HIV in the body cells.

HOLY FAITH INTERNATIONAL (P) LTD.

Holy Faith New Style Sample Paper-4 (Solved)

(Based on the Latest Design & Syllabus Issued by CBSE)

CLASS — 12th

BIOLOGY (THEORY)

Time Allowed : 3 Hours]

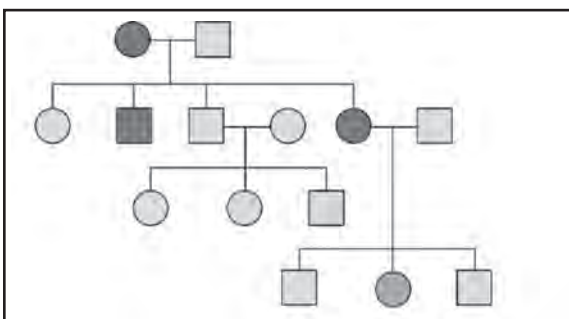
[Maximum Marks : 70

General Instructions : Same as Holy Faith New Style Sample Paper-1

SECTION—A

Q. No. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

1. Study the pedigree analysis of human given below and identify the type of inheritance along with an example : 1



- (a) Sex-linked recessive, Haemophilia
 (b) Sex-linked dominant, Vitamin D resistant rickets
 (c) Autosomal recessive, Sickle-cell anaemia
 (d) Autosomal dominant, Myotonic Dystrophy.

Ans. (d)

2. Rajesh and Mahesh have defective haemoglobin due to genetic disorders. Rajesh has too few globin molecules while Mahesh has incorrectly functioning globin molecules. Identify the disorder they are suffering from. 1

Rajesh	Mahesh
(a) Sickle cell anaemia-an autosome linked recessive trait	Thalassemia-an autosome linked dominant trait
(b) Thalassemia-an autosome linked recessive blood disorder	Sickle cell anaemia-an autosome linked recessive trait
(c) Sickle cell anaemia-an autosome linked recessive trait	Thalassemia-an autosome linked recessive blood disorder
(d) Thalassemia-an autosome linked recessive blood disorder	Sickle cell anaemia-an autosome linked dominant trait

Ans. (b)

3. Match the items in column I with those in column II and choose the correct answer. 1

Column I	Column II
1. Funicle	(A) Small opening of ovule
2. Integuments	(B) Stalk of ovule
3. Chalaza	(C) Protective envelopes of ovule
4. Hilum	(D) Junction part of ovule and stalk
5. Micropyle	(E) Basal part of the ovule

(a) 1 – B; 2 – C; 3 – E; 4 – D; 5 – A

(b) 1 – A; 2 – C; 3 – B; 4 – D; 5 – E

(c) 1 – B; 2 – C; 3 – A; 4 – D; 5 – E

(d) 1 – B; 2 – D; 3 – E; 4 – A; 5 – C

Ans. (a)

4. $(p+q)^2 = p^2 + 2pq + q^2 = 1$ represents an equation used in : 1

(a) population genetics

(b) Mendelian genetics

(c) biometrics

(d) molecular genetics.

Ans. (a)

5. Given below is a list of steps Meselsons and Stahl carried out in their experiment to prove that DNA replication is semiconservative. Select the option that gives the correct sequence of the steps followed by them. 1

(i) Bacteria transferred to a N14 medium and sampled every 20 mins.

(ii) All bacteria contain hybrid DNA (N14 and N15 DNA)

(iii) Bacteria grown in N15 medium for many generations

(iv) All bacteria contain N15 DNA

(v) Bacteria contain either all N14 DNA or all hybrid DNA.

(a) (ii) → (iv) → (iii) → (i) → (v)

(b) (i) → (ii) → (v) → (iv) → (iii)

(c) (iii) → (iv) → (i) → (ii) → (v)

(d) (iv) → (iii) → (ii) → (v) → (i)

Ans. (c)

6. Swathi was growing a bacterial colony in a culture flask under ideal laboratory conditions where the resources are replenished. Which of the following equations will represent the growth in this case? (Where population size is N, birth rate is b, death rate is d, unit time period is t, and carrying capacity is K). 1

(a) $dN/dt = KN$

(b) $dN/dt = rN$

(c) $dN/dt = rN(K - N/K)$

(d) $dN/dt = rN(K + N/K)$

Ans. (b)

7. Select the correct match. 1

Method	Mode of Action
--------	----------------

- | | |
|---------------|--|
| (A) Pill | (i) prevents sperm from entering female reproductive tract |
| (B) Condom | (ii) Prevents implantation |
| (C) Vasectomy | (iii) Prevents ovulation |
| (D) Copper-T | (iv) Semen contains no sperm. |
- (a) (A – iii) (B – iv) (C – i) (D – ii)
 (b) (A – iii) (B – iii) (C – i) (D – iv)
 (c) (A – iv) (B – i) (C – ii) (D – iii)
 (d) (A – iii) (B – i) (C – iv) (D – ii).

Ans. (d)

8. Select the pathogen mismatched with the symptoms of disease caused by it from the list given below : 1

(a) *Entamoeba histolytica* :

Constipation, abdominal pain.

(b) Epidermophyton: Dry scaly lesions on nail

(c) *Wuchereria bancrofti* : Chronic inflammation of lymphatic vessels of lower limb

(d) *Haemophilus influenzae* : Blockage of the intestinal passage.

Ans. (d)

9. BOD refers to the amount ofa..... that would be consumed if all theb..... in onec..... of water were oxidised byd.... . 1

(a) a – bacteria, b – CO₂, c – ml, d – oxygen

(b) a – microbes, b – organic matter, c – litre, d – bacteria

(c) a – oxygen, b – organic matter, c – litre, d – bacteria

(d) a – oxygen, b – organic matter, c – ml, d – bacteria

Ans. (c)

10. Industrial melanism was highlighted by : 1

(a) *Mimosa pudica*

(b) *Triticum aestivum*

(c) *Biston betularia*

(d) rock python

Ans. (c)

11. Given below is a sequence of bases in mRNA of a bacterial cell. Identify the amino acid that would be incorporated at codon position 3 and codon position 5 during the process of its translation. 1

3' AUCAGGUUUGUGAUGGUACGA 5'

(a) Phenylalanine, Methionine

(b) Cysteine, Glycine

(c) Alanine, Proline

(d) Serine, Valine

Ans. (a)

12. Total number of nucleotide sequences of DNA that codes for a hormone is 1530. 1

The proportion of different bases in the sequence is found to be Adenine = 34%, Guanine = 19%, Cytosine = 23%, Thymine = 19%.

Applying Chargaff's rule, what conclusion can be drawn?

(a) It is a double stranded circular DNA.

(b) It is a single stranded DNA.

(c) It is a double stranded linear DNA.

(d) It is a single stranded DNA coiled on Histones.

Q. 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.

Ans. (b)

13. Assertion (A): When white eyed, yellow bodied *Drosophila* females were hybridized with red eyed, brown-bodied males; and F₁ progeny was intercrossed, F₂ ratio deviated from 9 : 3 : 3 : 1. 1

Reason (R): When two genes in a dihybrid are on the same chromosome, the proportion of parental gene combinations is much higher than the non-parental type.

Ans. (a)

14. Assertion (A): Biologists are sure about how many prokaryotic species are living now. 1

Reason (R): The conventional taxonomic method are not suitable for identifying microbial species.

Ans. (d)

15. Assertion (A): Interferons are produced by virus infected cells. 1

Reason (R): Interferons stimulate inflammation at the site of injury.

Ans. (c)

16. Assertion (A): Humulin is more effective than the insulin produced by conventional methods. 1

Reason (R): Humulin is absorbed rapidly in the blood than the conventionally produced insulin.

Ans. (a)

SECTION—B

Attempt either option A or B

17. (A) Explain when is a genetic code said to be 2
(a) Degenerate
(b) Universal

Ans. (a) Some amino acids are encoded by more than one codon, hence called degenerate.

- (b) Genetic code is said to be universal when same codons specify the particular amino acid along with similar start and stop signal in majority of genes in various organisms. For example, UUU genetic codon were code for phenylalanine in all organisms

Or

- (B) A culture plate of *Lactobacillus* shows blue-coloured colonies and colourless colonies. Explain the principle involved in the formation of such variance in the colour of colonies.

Ans. Blue-white screening is a rapid and efficient technique for the identification of recombinant bacteria. It relies the activity of β -galactosidase enzyme which cleaves lactose in to glucose and galactose. The inactivation of enzyme is referred to as insertional inactivation.

The presence of chromogenic substrate given blue coloured colonies of the plasmid does not have any new inert in the setup. Thus it help in identification of colonies with recombinant DNA and without recombinant DNA of plasmid.

18. (A) Sea Anemone gets attached to the surface of the hermit crab. The kind of population interaction exhibited in this case is : 2
(a) amensalism (b) commensalism
(c) mutualism (d) parasitism

Ans. (c) Explanation : The sea anemone eats food that the hermit crab releases and the hermit crab is protected from predators by the painful sting of the sea anemone's tentacles

Or

- (B) How would you differentiate between gross primary productivity from net primary productivity and secondary productivity of an ecosystem ?

Ans.

Gross Primary Productivity	Net Primary Productivity	Secondary Productivity
The amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis is called gross primary productivity.	Gross primary productivity minus respiration losses is called net primary productivity. It is the rate at which all plants in an ecosystem produce net useful chemical energy.	The rate of formation of new organic matter by consumers is called secondary productivity.

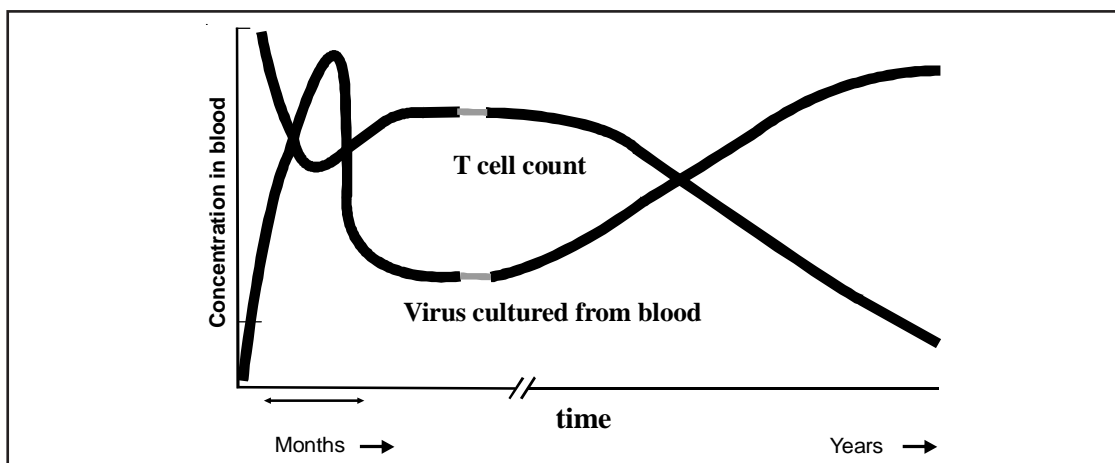
19. How is the use of "microinjection" different from using the 'method of biolistics' in biotechnology ? Explain. 2

Ans. Microinjection is the method of introducing foreign genes into a host cell by injecting the DNA directly into the nucleus by using microneedle or micropipette.

Method of Biolistics : In this method, Gene gun is used for bombarding micro projectiles (gold or tungsten particles) coated with the foreign DNA with great velocity into the target cell.

20. Given below is the relationship between the HIV levels in the blood and helper T cell count in a person detected with AIDS. Study the relationship and answer the questions that follow. 2

- (A) What kind of relationship is observed in the virus levels and the immune response after some days of the initial infection?
(B) Does it completely clear the virus from the body permanently ? Give reason for your answer.



- Ans.** (A) HIV enters into T-lymphocytes and produce progeny viruses. The progeny viruses released in blood attach new T-lymphocytes. This is repeated and there is progressive decrease in number of T-lymphocytes.
- (B) The HIV virus persists in the body and damage Immune system. Due to decrease in number of T-lymphocytes the person start suffering from infectious disease.

Attempt either option A or B

- 21. (a) Explain the process of development of male gametophyte in an angiosperms? 2**
(b) Why is it called a male gametophyte?

- Ans.** (a) The development of male gametophyte in angiosperms begins with the division of the pollen mother cell in the anther. This division produces four haploid microspores. Each microspore undergoes a mitotic division to produce a two-celled structure known as a pollen grain. The two cells in the pollen grain are the generative cell and the tube cell. The generative cell further divides to produce two male gametes.
- (b) The pollen grain or male gametophyte is called so because it produces male gametes, namely the sperm cells, which fuse with the female gametes during fertilization to form the zygote.

Or

- (B) Name the hormone composition of oral contraceptive used by human female. Explain how does it act as contraceptive.**

- Ans.** (i) Oral contraceptive pills contain progesterone alone or a combination of progesterone and oestrogen hormones.
- (ii) Effective contraceptive pills :
- Inhibition of ovulation
 - Inhibition of motility and secretory activity of fallopian tubes.
 - Changes in the endometrium layer of uterus to make it unsuitable for implantation.
- (iii) 'Saheli' is a contraceptive pill that contains a non-steroidal compound called Centchroman.

SECTION—C

- 22. One of the major approaches of crop improvement programme is Artificial Hybridization. Explain the steps involved in making sure that only the desired pollen grain pollinate the stigma of a bisexual flower by a plant breeder. 3**

- Ans.** Artificial hybridization is used to incorporate desired traits in the plant by the method of cross breeding. The major steps involved in making sure that only the desired pollen grain pollinates the stigma of a bisexual flower :
- (i) **Selection of parents :** The first step involves selecting the two plants to be used for artificial hybridization. The parents should have the desirable traits that are complementary to each other. For example, one of the 2 parent might have a high yield but be susceptible to disease, while the other parent might have a low yield but be resistant to disease.
- (ii) **Emasculation :** The plant breeder removes the anthers

of a bisexual flower of the female parent plant to prevent self-pollination or unwanted pollination from other sources.

- (iii) **Bagging :** The emasculated flower is covered with a bag made of a suitable material to prevent unwanted pollination.
- (iv) **Pollination :** The desired pollen grains are collected from the male parent plant and transferred to the stigma of the emasculated female parent flower.

Labeling : The emasculated and bagged flowers are labeled with the identity of the parents, the date of pollination, and any other relevant information.

Development : The pollinated flower is left to develop into a fruit, and the resulting seeds are collected and sown to grow hybrid plants. By following these steps, plant breeders can ensure that only the desired pollen grain pollinates the stigma of a bisexual flower, leading to the development of new and improved crop varieties with desirable traits

- 23. "Plasmodium protozoan needs both a mosquito and a human host for its continuity" Explain. 3**

- Ans.** (a) Plasmodium enters the human body as sporozoites (infectious form) through the bite of infected female Anopheles mosquito. The parasites initially multiply within the liver cells and then attack the red blood cells (RBCs) resulting in their rupture. The rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever recurring every three to four days. When a female Anopheles mosquito bites an infected person, these parasites enter the mosquito's body, the parasites multiply within them to form sporozoites that are stored in their salivary glands. When these mosquitoes bite a human, the sporozoites are introduced into his/her body, thereby initiating the events. Hence, the malarial parasite Plasmodium requires two hosts – human and mosquitoes to complete its life cycle.

- 24. (a) There was loss of biodiversity in an ecosystem due to a new construction project in that area. What would be its impact on the ecosystem? State any three. 3**
(b) List any three major causes of loss of biodiversity ?

- Ans.** (a) Impacts of loss of biodiversity on the ecosystem :
- (i) Increased variability in certain ecosystems – processes such as plant productivity, water use, pest and disease cycles.
- (ii) Decline in plant production.
- (iii) Lowered resistance to environmental perturbations such as drought.
- (b) (i) Co-extinctions
(ii) Habitat loss and fragmentation
(iii) Over-exploitation

- 25. List the changes that occur when an ovule matures into seed. 3**

- Ans.** (i) Integuments of ovules harden and become tough protective seed coats.
- (ii) The micropyle remains as a small pore in the seed coat.
- (iii) As the seed matures, its water content is reduced.
- (iv) Seeds become relatively dry. It has 10–15 per cent moisture by mass.

- (v) The general metabolic activity of the embryo slows down.
 (vi) The embryo may enter a state of inactivity called dormancy

26. (a) Name three molecular diagnostic techniques for diagnosis of a disease. 3
(b) List three advantages of molecular diagnostic techniques over conventional method of diagnosis.

Ans. (a) The three techniques that serve the purpose of early diagnosis are Recombinant DNA technology, Polymerase Chain Reaction (PCR) and Enzyme-Linked Immunosorbent Assay (ELISA).

(b) Three advantages of molecular diagnostic techniques over conventional method of diagnosis are as under :

- (i) Molecular diagnostics is a more sensitive method allowing detection of lower amounts of infectious agents and giving the ability to detect infections earlier than the conventional method.
- (ii) Molecular diagnostic techniques enable faster and more accurate results compared to conventional methods. With advancements such as polymerase chain reaction (PCR) and nucleic acid amplification techniques, genetic material can be amplified and analyzed rapidly, allowing for timely diagnosis and prompt initiation of treatment.
- (iii) Molecular diagnostic techniques enable early detection of diseases, including infectious diseases and genetic disorders. Detecting diseases at an early stage improves the chances of successful treatment and can help in implementing preventive measures

27. Name the two fundamental trophic levels and describe the general makeup of each. 3

Ans. The two fundamental trophic levels include the following:

- (i) Producers (Autotrophic organisms). The green plants are the producers in any ecosystem. They also include photosynthetic bacteria. The producers use solar energy of the sun during photosynthesis whereby carbon dioxide is assimilated and the light energy is converted into chemical energy. This energy is locked up into the energy-rich carbon compounds i.e. carbohydrates. The oxygen that is evolved as a by-product in photosynthesis is used in respiration by all living organisms.
- (ii) Consumers (Heterotrophic organisms). They are the living members of the ecosystem which consume the food synthesised by the producers. All living animals are thought to be consumers. The consumers may be of the following types :
 - Primary consumers (also called first order consumers) which are purely herbivorous and depend upon green plants i.e. on producers for their food e.g., Cow, Goat, Rabbit, Deer, Grasshopper and other insects.
 - Secondary consumers (also called second order consumers) are carnivorous animals and eat flesh of herbivorous animals e.g., birds, fishes and wolf.

- Tertiary consumers are the carnivorous animals that eat other carnivores e.g. man, lion

28. (A) How are the following formed and involved in DNA packaging in a nucleus of a cell? 3

(i) Histone octamer

(ii) Nucleosome

(iii) Chromatin

(B) Differentiate between Euchromatin and Heterochromatin

Ans. (a) Packaging of DNA (i) Histone octamer: Five types of histone proteins (H1, H2A, H2B, H3 and H4) are involved. Out of these, four of them H2A, H2B, H3 and H4 occur in pairs to produce histone octamer also called nu body. Histones are organised in a form of compact unit formed of 8 molecules hence called histone octamer.

(ii) Nucleosome: The unit of compaction of DNA is nucleosome. A typical nucleosome contains 200 bp of DNA helix. It constitute the repeating unit of a structure in nucleus called chromatin, that are stained threadlike (coloured) bodies seen in nucleus.

(iii) Chromatin: Linker DNA connects two adjacent nucleosomes. It bears H1 protein. As a result chain is formed called chromatin. Nucleosome chain gives 'beads on string' appearance under electron microscope. Chromatin are repeating units of structure located on nucleosome.

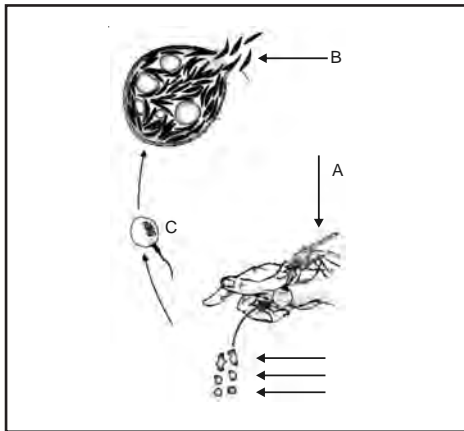
(b) Differences between heterochromatin and euchromatin

Heterochromatin	Euchromatin
1. Darkly stained.	1. Lightly stained.
2. Condensed regions of chromatin fibres.	2. Less tightly coiled regions of chromatin fibres.
3. Transcriptionally inactive or less active.	3. Transcriptionally active.
4. Less affected by temperature, sex or age. It is not acetylated.	4. More affected by temperature, sex or age. It is acetylated during interphase.

Euchromatin is more active transcriptionally.

SECTION—D

29. Study a part of life cycle of malarial parasite given below Answer the questions that follow : 4



- (a) Mention the roles of 'A' in the life cycle of malarial parasite.
 (b) Name the event 'C' and the organ where this event occurs.

Attempt either sub part c or d

- (c) Identify the organ 'B' and the cells being released from it.

Or

- (d) not when and how the symptoms of the disease appear.

- Ans. (a) A is female anopheles mosquito. It acts as a vector. It transmits the stages of plasmodium parasite from infected person to healthy person.
 (b) Event (c) is fusion of male and female gamete in the gut of female anopheles mosquito.
 (c) Organ B is salivary glands of female anophele mosquito. Sporozoites infective stage released by rupturing of sporocyst and store in these glands.

Or

- (d) Symptoms of malaria appear when harmon is released in the blood at the complation of sohizogany.

30. Latest researches in the field of biotechnology are proving more useful in contributing to improved production and propagation of new cultivars which prove better in relation to nutritional quality, disease and salt resistance and other characters. With improvement of genetic engineering techniques, the time for generating and evaluating new germplasm can be drastically reduced. Chemical and biotechnological progresses have opened new frontiers to products of improved value from agricultural raw materials. 4

- (a) Name two plants with high nutritive value prepared by genetic engineering.
 (b) What is Bt cotton.

Attempt either subpart c or d

- (c) Write one problem associated with generatically modified.

Or

- (d) Name the transgenic animal which provide nutritinally such milk.

- Ans. (a) (i) Golden rice (ii) Flavr Sava Tomato
 (b) Bt cotton is a transgenic plant having cry genes which produce cry protein that provide protection from pink boolworm.
 (c) Toxicity and various types of allergy may be produced by tgransgence food.

Or

- (d) Rosie

SECTION—E

31. (A) (i) Describe the arrangement of nuclei and cells in a mature embryo sac of a typical angiosperm. 5
 (ii) Explain the device the flowering plants have developed to prevent the following types of pollination.

- (a) Prevents both autogamy and geitonogamy.
 (b) Prevents autogamy but not geitonogamy.

Or

- (B) Suggest and explain the assisted reproductive techniques which will help a couple to have children, where the female had a blockage in the fallopian tube and the male partner had a low sperm count.

- Ans. (a) The mature embryo sac of a typical angiosperm, also known as the female gametophyte, contains eight nuclei and seven cells arranged in a specific manner. There are three cells at the micropylar end of the embryo sac, known as the egg apparatus, which consists of two synergids and an egg cell. At the center of the embryo sac, there are two polar nuclei that fuse to form a diploid central cell. There are also three antipodal cells at the chalazal end of the embryo sac.

- (b) Flowering plants have developed several devices to prevent self-pollination, which include:

- (i) Preventing both autogamy and geitonogamy: Flowers that prevent both autogamy and geitonogamy have several mechanisms to ensure crosspollination. One such mechanism is self-incompatibility, which involves the plant's ability to reject its own pollen. This can occur through a gametophytic or sporophytic mechanism, depending on the species. Another mechanism is dichogamy, where the male and female reproductive structures, such as the stamens and pistils, mature at different times.

- (ii) Preventing autogamy but not geitonogamy: Flowers that prevent autogamy but allow geitonogamy have mechanisms that promote crosspollination with other flowers on the same plant. One such mechanism is heterostyly, which involves the production of flowers with different types of styles and stamens that promote cross-pollination between flowers with different morphologies. Another mechanism is self-pollination avoidance through spatial separation, such as the production of flowers at different heights or on different parts of the plant to promote outcrossing.

Or

Ans. In cases where the female partner has a blockage in the fallopian tube and the male partner has a low sperm count, there are various assisted reproductive techniques (ARTs) that can help the couple conceive:

- (i) **In-vitro fertilization (IVF)** : IVF is a procedure in which eggs are removed from the female's ovary and fertilized with sperm in a laboratory. The fertilized eggs or embryos are then transferred back into the female's uterus. In cases where the female partner has a blocked fallopian tube, IVF can help bypass the blocked tube and allow fertilization to occur.

- (ii) **Intracytoplasmic sperm injection (ICSI)** : ICSI is a technique where a single sperm is injected directly into the egg in the laboratory. This is done when the male partner has a low sperm count, poor motility or other issues with the sperm.

- (iii) **Gamete intrafallopian transfer (GIFT)** : GIFT is a technique where eggs are removed from the female partner's ovaries and mixed with sperm in a laboratory. The mixture is then immediately placed in the female partner's fallopian tube to allow for fertilization to occur naturally

Attempt either option A or B

32. (A) Answer the following questions based on Bt crops : 5

- (i) Why do farmers prefer to grow Bt cotton crop than genetically unmodified cotton crops?
 (ii) Name any two insects that are killed by Bt toxin.
 (iii) Explain the mechanism by which Bt toxin kills the insects but not the bacterium which possesses the toxin.

- Ans.** (a) Farmers prefer growing Bt cotton crops over genetically unmodified cotton crops because Bt cotton is pest resistant and it overcomes the use of pesticides that are harmful for the soil.
 (b) Two insects that are killed by Bt toxin are the cotton bollworm and corn borer.
 (c) Bt toxin (Cry or crystal insecticidal protein) works by

binding to specific receptors in the gut lining of susceptible insect larvae, causing the gut wall to break down, which leads to the insect's death. The toxin is only activated under specific conditions of alkaline environment of the insect's gut. The bacteria constituting the Bt gene and producing the toxin, on the other hand, have a neutral pH environment, which does not activate the toxin. Additionally, Bt toxin is not absorbed by the plant tissues but remains localized in the cotton bolls and other plant parts, making it safe for human use.

Or

- (B) (i) State the role of a selectable marker in r-DNA technology.

(ii) Name one such selectable marker which is considered to be useful for E.coli.

(iii) Give one reason why is it considered to be a useful marker

- Ans.** (a) Role of Selectable markers in r-DNA technology is as follows :

- They are used to select transformants containing the rDNA molecule eliminating nontransformants.
- (b) The genes encoding resistance to antibiotics (e.g. tetracycline, ampicillin, etc.) are useful selectable markers for E.coli.
- (c) The vector requires a selectable marker, which helps in identifying and eliminating nontransformants and selectively permitting the growth of the transformants. The genes encoding resistance to antibiotics, such as ampicillin and tetracycline, are considered useful selectable markers for E. coli as the normal E. coli cells do not carry resistance against any of these antibiotics.

Attempt either option A or B

33. (A) (i) State the role of VNTRs in DNA fingerprinting. 5

(ii) What are the aims of bioinformatics?

Or

- (B) (i) A true breeding pea plant, homozygous dominant for inflated green pods is crossed with another pea plant with constricted yellow pods (ffgg). With the help of punnett square show the above cross and mention the results obtained phenotypically and genotypically in F1 generation?

(ii) With the help of one example, explain the phenomena of co-dominance and multiple allelism in human population.

- Ans.** (i) Variable Number of Tandem Repeats (VNTRs) (mini satellites) are specific short nucleotide repeats in the DNA of an individual and these vary in number from person to person but are inherited. These are the 'Variable Number Tandem Repeats' (VNTRs).

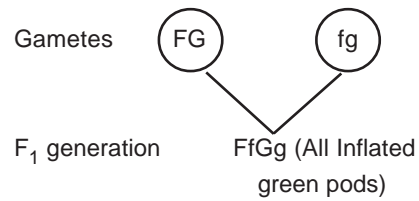
These are also called 'minisatellites'. Each individual inherits these repeats from her/his parents which are used as genetic markers in a personal identity test. For example, a child might inherit a chromosome with six tandem repeats from the mother and the same tandem repeated four times in the homologous chromosome inherited from the father. The half of VNTR alleles of the child resemble that of the mother and half that of the father.

- (ii) Aims of bioinformatics :
 - (i) To spread scientifically investigated knowledge for the benefit of the research community.
 - (ii) To transform the biological polymeric sequences into sequences of digital symbols and to store them as databases.
 - (iii) To develop a variety of methods and tools of software for data analysis.

Or

Ans. (i)

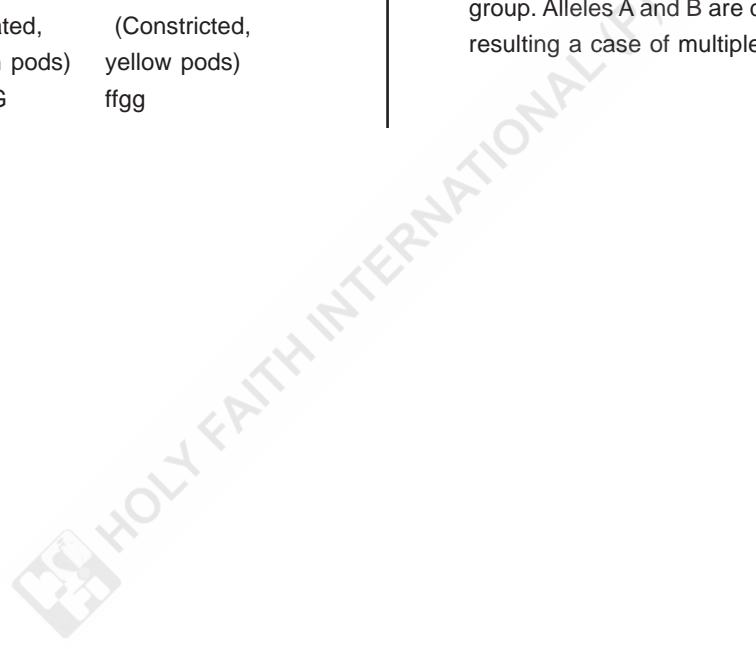
	(Inflated,	(Constricted,
Parents	green pods)	yellow pods)
Genotypes	FFGG	ffgg



	FG	FG
fg	FfGg	FfGg
fg	FfGg	FfGg

- (ii) In case of co-dominance two alleles for a trait are equally expressed.

Example : ABO blood groups are controlled by the gene I. The gene I has three alleles I^A, I^B and I^O. These alleles determine the type of sugar on RBC surface. Alleles I^A and I^B are co-dominant and express AB blood group. Alleles A and B are dominant and O is recessive, resulting a case of multiple allelism.



Holy Faith New Style Sample Paper–6

(Based on the Latest Design & Syllabus Issued by CBSE)

CLASS — 12th
BIOLOGY (THEORY)

Time Allowed : 3 Hours]

[Maximum Marks : 70

General Instructions : Same as Holy Faith New Style Sample Paper—1

SECTION—A

Q. No. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

1. Match the terms in Column I with their description in Column II and choose the correct option : 1

Column I	Column II
(I) Dominance	(i) Many genes govern a single character
(II) Codominance	(ii) In a heterozygous organism, only one allele expresses itself
(III) Pleiotropy	(iii) In a heterozygous organism, both alleles express themselves fully
(IV) Polygenic inheritance	(iv) A single gene influences many characters

- (a) (I)-(ii), (II)-(iii), (III)-(iv), (IV)-(i)
 (b) (I)-(iii), (II)-(ii), (III)-(iv), (IV)-(i)
 (c) (I)-(iv), (II)-(i), (III)-(ii), (IV)-(iii)
 (d) (I)-(i), (II)-(ii), (III)-(iii), (IV)-(iv)

Ans. (a)

2. Match the items in Column I with those of Column II and choose the correct alternative : 1

Column I	Column II
A. Sickle-cell anaemia	1. 7th chromosome
B. Phenylketonuria	2. 4th chromosome
C. Cystic fibrosis	3. 11th chromosome
D. Huntington's disease	4. X-chromosome
E. Colour blindness	5. 12th chromosome

- (a) A = 1, B = 3, C = 4, D = 2, E = 5
 (b) A = 2, B = 3, C = 4, D = 5, E = 1
 (c) A = 3, B = 5, C = 1, D = 2, E = 4
 (d) A = 2, B = 1, C = 3, D = 5, E = 4

Ans. (c)

3. Refer the given statements. 1

- (i) Outer exine is made up of sporopollenin.
 (ii) Inner intine is pecto-cellulosic in nature.
 (iii) Generative cell is bigger and contains abundant food reserve.
 (iv) Vegetative cell is small and floats in the cytoplasm of the generative cell.

Which of the given statements are not true regarding the structure of pollen grain?

- (a) (i) and (ii) (b) (ii) and (iii)
 (c) (iii) and (iv) (d) (i) and (iv).

Ans. (c)

4. Evolutionary convergence is the development of a : 1

- (a) common set of functions in groups of different ancestry.
 (b) dissimilar set of functions in closely related groups.
 (c) common set of structures in closely related groups.
 (d) dissimilar set of functions in unrelated groups

Ans. (a)

5. A codon is a 'triplet of bases' was suggested by : 1

- (a) Marshall Nirenberg
 (b) Har Gobind Khorana
 (c) George Gamow
 (d) Francis Crick

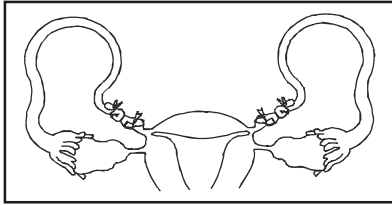
Ans. (c)

6. In a growing population of a country : 1

- (a) Pre-reproductive individuals are more than the reproductive individuals
 (b) Reproductive individuals are less than the post-reproductive individuals
 (c) Reproductive and pre-reproductive individuals are equal in number
 (d) Pre-reproductive individuals are less than the reproductive individuals

Ans. (a)

7. What is the figure given below showing in particular? 1



- (a) Uterine cancer (b) Tubectomy
(c) Vasectomy (d) Ovarian cancer.

Ans. (b)

8. To produce 1600 seeds, the number of meiotic divisions required will be : 1

- (a) 2400 (b) 2000
(c) 1600 (d) 1800

Ans. (c)

9. Match the following list of bioactive substances with their roles : 1

Bioactive Substance	Role
(i) Statin	(A) Removal of oil stains
(ii) Cyclosporin A	(B) Removal of clots from blood vessels
(iii) Streptokinase	(C) Lowering of blood cholesterol
(iv) Lipase	(D) Immunosuppressive agent

Choose the correct match :

- (a) (i) (B), (ii) (C), (iii) (A), (iv) (D)
(b) (i) (D), (ii) (B), (iii) (A), (iv) (C)
(c) (i) (D), (ii) (A), (iii) (B), (iv) (C)
(d) (i) (C), (ii) (D), (iii) (B), (iv) (A)

Ans. (d)

10. Which one of the following scientists' names is correctly matched with the theory put forth by him? 1

- (a) De Vries — Natural selection
(b) Mendel — Theory of Pangenesis
(c) Weismann — Theory of continuity of germplasm
(d) Pasteur — Inheritance of acquired characters

Ans. (c)

11. A template strand in a bacterial DNA has the given base sequence : 1

5' – AGGTTTAACG – 3'

What would be the RNA sequence transcribed from this template strand ?

- (a) 5' – CGUUAACCU – 3'
(b) 5' – AGGUUUUJCG – 3'
(c) 5' – TCCAAATTGC – 3'
(d) 5' – AGGTTTAACG – 3'

Ans. (a)

12. A stretch of an euchromatin has 200 nucleosomes. How many bp will there be in the stretch and what would be the length of the typical euchromatin? 1

- (a) 20,000 bp and 13,000 × 10⁻⁹ m
(b) 10,000 bp and 10,000 × 10⁻⁹ m
(c) 40,000 bp and 13,600 × 10⁻⁹ m
(d) 40,000 bp and 13,900 × 10⁻⁹ m

Ans. (c)

Q. 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 (A) : Mendel formulated the laws of heredity.

Reason (R) : Mendel did not perform the study of one character at a time. 1

Ans. (c)

14. Assertion (A) : National parks have been set up to protect wildlife. 1

Reason (R) : Biosphere reserves have greater importance than the national parks.

Ans. (b)

15. Assertion (A) : The Covid 19 virus has a shorter lifespan and evolves into new strains at a fast speed.

Reason (R) : RNA being unstable, mutates at a faster rate. 1

Ans. (a)

16. Assertion (A) : Bacillus thuringiensis produce proteins that kill lepidopterans.

Reason (R) : Bt toxin is coded by a gene cryIAc named cry. 1

Ans. (b)

(SECTION—B)

Attempt either option A or B

17. (A) Why does the lac operon shut down some time after the addition of lactose in the medium where E.coli was growing ? Why low level expression of lac operon is always required ? 2

Ans. Lactose is the substrate for the enzyme beta-galactosidase and act as a inducer (regulating the switch of the lac operon). A repressor protein binds to the operator region of the lac operon to prevent RNA polymerase from transcribing the operon. The inducer, such as lactose or allolactose, inactivates the repressor and hence RNA polymerase can access to the promoter and transcription proceeds. After addition of lactose to the cell, enzyme beta-galactosidase completely breakdown lactose to glucose and galactose. Therefore, there is no more lactose (inducer) to bind to the repressor protein, hence

the repressor protein is free to bind to the operator, and the lac operon shuts down. A very low level of expression

of lac operon has to be present in the cell all the time, otherwise lactose cannot enter the cells.

Or

(B) The schematic representation given below shows a DNA strand and two types of mutations in the DNA strand. 2

Original template	A	U	G	C	A	G	A	C	A	U	C	U	U	A	G
	Met			Gln			Thr		Ser			Stop			
Mutation I	A	U	G	A	A	G	A	C	A	U	C	U	U	A	G
	Met			Lys			Thr		Ser			Stop			
Mutation II	A	U	G	A	G	A	C	A	U	C	C	U	A	G	
	Met			Arg			His		Leu						

(i) Identify the type of mutation exhibited in I and II.

(ii) Which of the above mutation is more harmful? Give reason.

Ans. (i) Mutation I—Point mutation.

Mutation II—Frame-shift mutation.

(ii) Deletion of base pairs of DNA, causes from-shift mutation. It changes the reading frame from the point of insertion and deletion. It changes the complete change of protein. The presence of chromogenic substrate gives blue coloured colonies if the plasmid does not have any new inert in the set up. Thus it help in identification of colonies with recombinant DNA and without recombinant DNA of plasmid.

Attempt either option A or B

18. (A) List a few adaptations which parasites have developed. 2

Ans. Parasites have evolved one or more of the following adaptations:

- Loss of unnecessary sense organs
- Presence of hooks/adhesive organs and suckers
- Loss of digestive system
- High reproductive capacity

Or

(B) Explain with an example, why is the length of a food chain in an ecosystem generally limited to 3–4 trophic levels?

Ans. According to the 10 percent law of transfer of energy, about 90 percent of energy is degraded into heat in a food chain at each trophic level, and only 10 percent of energy is transferred to the next trophic level. The length of a food chain in an ecosystem is generally limited to 3–4 trophic levels because the amount of energy decreases as we move up the trophic levels, resulting in a limited amount of usable energy remaining after four trophic levels. This is why most food chains typically have only three to four trophic levels

19. (i) While cloning vectors, which of the two will be preferred by biotechnologists, bacteriophages or plasmids? Justify with reason. 2

(ii) Name the first transgenic cow developed and state the improvement in the quality of the product produced by it.

Ans. (i) Biotechnologists prefer bacteriophages for cloning over plasmids because they have very high copy numbers of their genome within the bacterial cells, whereas some plasmids may have only one or two copies per cell and others may have 15–100 copies per cell. Phage vectors are more efficient than plasmids for cloning of large DNA fragments.

(ii) Transgenic cow Rosie produced human protein-enriched milk (2.4 grams per litre).

20. How has the discovery of antibiotics helped mankind in the field of medicine? 2

Ans. The discovery of antibiotics has revolutionized the field of medicine by providing effective treatments for bacterial infections. Antibiotics are drugs that kill or inhibit the growth of bacteria, and they have saved count less lives by curing previously deadly bacterial infections such as pneumonia, tuberculosis, and sepsis. In addition to treating infections, antibiotics are also used to prevent infections during surgeries and other medical procedures.

Attempt either option A or B

21. (A) You are conducting artificial hybridisation on papaya and potato. Which one of them would require the step of emasculation and why? However, for both you will use the process of bagging. Justify giving one reason. 2

Ans. (i) Potato : Potato plant has bisexual flower, its flower consists both male and female reproductive parts, and the plant is monoecious. Hence it needs emasculation to prevent autogamy.

(ii) Papaya : In case of papaya plant, male and female flowers are present on separate plants, that is each plant is either male or female (dioecious). This condition prevents both autogamy and geitonogamy. Bagging is required for both papaya and potato to prevent unwanted pollination by foreign pollen. This ensures that only the desired pollen is used for pollination and the resulting hybrid is true to the desired traits.

Or

(B) Suggest the reproduction-related aspects in which counselling should be provided at the school level.

Ans. Counselling related to reproduction at the school level should include :

- Menstrual hygiene and management.

- (ii) Contraceptive methods and their safe use.
- (iii) Sexually transmitted diseases and their prevention.
- (iv) Hygiene of reproductive organs.
- (v) Emotional and psychological changes during adolescence.

SECTION—C

22. (a) How many types of RNA polymerases are there in a eukaryote cell? Mention which one of them transcribes hnRNA? 3

(b) Write the changes that hnRNA undergoes before it leaves the nucleus as mRNA.

Ans. (a) In a eukaryotic cell, there are three types of RNA polymerases, namely RNA polymerase I, II, and III. RNA polymerase II (Pol II) is responsible for transcribing hnRNA (heterogeneous nuclear RNA), which is a precursor to mature mRNA (messenger RNA). Pol II is a complex enzyme that recognizes and binds to the promoter region of the noncoding DNA strand, to initiate transcription of protein-coding genes.

(b) hnRNA (heterogeneous nuclear RNA) undergoes several changes or processing steps before it is transported out of the nucleus as mature mRNA (messenger RNA). These processing steps include :

- (i) **Capping** : The 5' end of the hnRNA molecule is modified by the addition of a methyl guanosine triphosphate cap. This cap protects the mRNA from degradation and assists in its translation.
- (ii) **Polyadenylation** : The 3' end of the hnRNA molecule is modified by the addition of a poly(A) tail. This tail is a string of adenylate residue (200-300) that is important for stabilizing the mRNA and promoting its translation by transporting it out of the nucleus.
- (iii) **Splicing** : The hnRNA molecule contains both exons (coding regions) and introns (non-coding regions). Before leaving the nucleus, the introns are removed by a process called splicing, and the exons are joined together to form a continuous coding sequence. Thus mature mRNA molecule only contains the coding region of the protein.
- (iv) Once these processing steps are complete, the mature mRNA molecule is ready to be transported out of the nucleus and into the cytoplasm, where it can be translated into protein by the ribosomes

23. (a) Name the category of drugs represented by the chemical structure given above. 3

(b) If the methyl group is substituted by acetyl group we get a bitter crystalline compound. Name the compound.

(c) Name the natural source of these compounds.

(d) State the harmful effects of this class of drugs on the human.

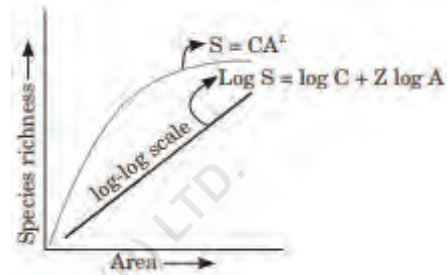
- Ans. (a) The category of drug is called opioids.
- (b) Heroin, commonly called smack.
 - (c) It is extracted from the latex of poppy plant *Papaver somniferum*.
 - (d) It is generally taken by snorting and injection, that acts as a depressant and slows down body functions.

24. Given below is an equation describing the Species-Area relationship between species richness and area for a wide variety of taxa as angiosperm plants, birds, bats etc. 3

$$S = CA^Z$$

- (a) Give a graphical representation of the given equation showing species-Area relationship.
- (b) What does 'S' represent in the given equation?
- (c) What is the value of 'Z' (regression coefficient) for frugivorous birds and mammals in the tropical forests of different continents ?

Ans. (a)



- (b) S represents species richness.
- (c) For frugivorous (fruit-eating) birds and mammals in the tropical forests of different continents, the slope (Z) is found to be 1.15

25. Write about the structure of microsporangium. 3

Ans. A microsporangium is more often circular in outline and is surrounded by four layered wall :

- (i) The outermost layer is the single layer of epidermis.
- (ii) The second layer is endothecium, where cells develop thickenings.
- (iii) Middle layer is of 2-4 layered.
- (iv) Tapetum, the innermost layer, is of large diploid/polyploid and binucleate or multinucleate cells which is responsible for providing nutrients to the developing pollen grains.
- (v) Within the microsporangium, there are four pollen sacs or microsporangia, which contain the microspore mother cells. Each microsporangium is separated by a connective tissue, which helps in the dehiscence or opening of the anther during pollination.

26. Answer the following questions based on Bt crops : 3

- (a) Why do farmers prefer to grow Bt cotton crop than genetically unmodified cotton crops?
- (b) Name any two insects that are killed by Bt toxin.
- (c) Explain the mechanism by which Bt toxin kills the insects but not the bacterium which possesses the toxin.

- Ans. (a) Farmers prefer growing Bt cotton crops over genetically unmodified cotton crops because Bt cotton is pest resistant and it overcomes the use of pesticides that are harmful for the soil.
- (b) Two insects that are killed by Bt toxin are the cotton bollworm and corn borer.
 - (c) Bt toxin (Cry or crystal insecticidal protein) works by binding to specific receptors in the gut lining of susceptible insect larvae, causing the gut wall to break down, which leads to the insect's death. The toxin is only activated under specific conditions of

alkaline environment of the insect's gut. The bacteria constituting the Bt gene and producing the toxin, on the other hand, have a neutral pH environment, which

does not activate the toxin. Additionally, Bt toxin is not absorbed by the plant tissues but remains localized in the cotton bolls and other plant parts, making it safe for human use.

27. Show the processes involved in decomposition of detritus.

3

Ans. Process of decomposition.

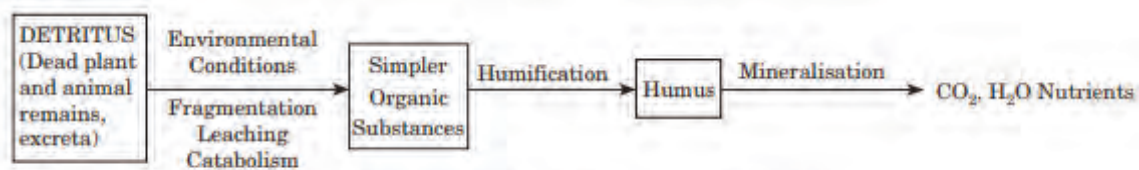


Fig. Processes involved in decomposition of detritus

- (i) **Fragmentation** : Detrivores break down detritus into smaller particles.
- (ii) **Leaching** : Water-soluble inorganic nutrients seep inside soil and get precipitated as unavailible salt.
- (iii) **Catabolism** : Here, bacteria and fungus degrade detritus by their enzymes into simple inorganic ions.
- (iv) **Humification** : Humification is the process where the remains of organic material are transformed into a dark, amorphous substance called humus. It occurs through the action of fungi and bacteria.
- (v) **Mineralisation** : The process in which humus gets degraded by microbes and releases inorganic nutrients is known as mineralisation.

28. (A) (i) Why does replication occur in small replication forks and not in entire lengths ? 3

(ii) Why is DNA replication continuous and discontinuous in a replication fork ?

(B) State the importance of origin of replication in a replication fork.

- Ans. (a) Replication occurs in small opening of DNA helix called replication forks for very long DNA molecules. The reason is in case of long DNA molecules, the two strands of DNA cannot be separated in its entire length due to very high energy demand.
- (b) DNA dependent DNA polymerase catalyses DNA polymerisation only in one direction, that is, 5'→3'. DNA strands are anti-parallel and have opposite polarity. So on template strand with polarity 3'→5' DNA replication is continuous while on the template strand with polarity 5'→3' replication is discontinuous.
- (c) Replication cannot start randomly at any point in DNA. It requires a definite region of sequences where the replication originates. This site is called origin of replication.

SECTION—D

29. Condition which interferes with the normal functioning of the body and impairs the health, is called disease. It involves morphological, physiological or psychological disturbance in some

body parts. It may be due to environmental factors or pathogens or genetic anomalies or life style diseases (e.g. nature of food and water taken; not understanding proper rest and number of infectious diseases have ill-effects on human return white some of these are fatal AIDS is one of the highly serious pandemic diseases. Though a number of drugs are available but none of these provides absolute protection against the disease. 4

(a) What is peculiar about HIV than the other viruses ?

(b) What are difficulties against developing the AIDS vaccine ?

- Ans. (a) AIDS virus is a retrovirus having ssRNA as genetic material and the enzyme Reverse transcriptase which can synthesize ds-DNA on SS RNA by reverse transcription.
- (b) Because like other viruses, AIDS virus cannot be cultured on the synthetic culture media.
- (c) A number of vaccines are being tried in different parts of the world e.g. HIV Vaccine Trial Network (HVTN) conducted V-520 vaccine trial in December, 2004 while RV-144 vaccine trial was conducted in Thailand in 2003 and results were presented in 2011.
- (d) HIV binds CD-4 receptor of Helper T-cells by its GP-120 protein. Then viral genomic RNA and enzyme reverse transcriptase enter inside the Helper-T cell, Viral RNA synthesise ds-DNA by reverse transcription ds-DNA integrates with host's cell DNA to form a prophage. The viral genome synthesizes large number of viral RNA molecules, each of which gets surrounded by a proteinous capsid to complete Large number of viruses. Finally, the host cell is lysed and many HIV particles are released which infect new Helper-T cells.

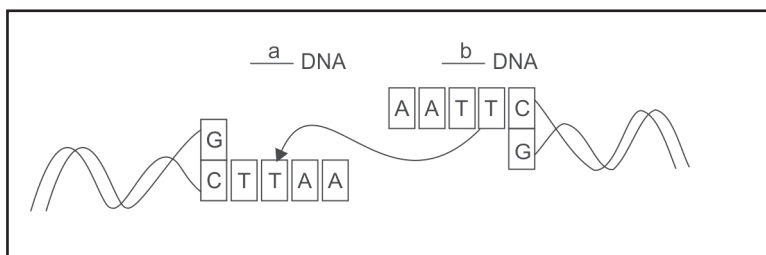
Attempt either subpart c or d

(c) Which vaccine trials are being conducted in the world to develop AIDS vaccine ?

Or

(d) How HIV attacks and multiplies inside its host cell ?

30. Study the linking of DNA fragments shown below : 4



- (a) Name 'a' DNA and 'b' DNA.
 (b) Name the restriction enzyme that recognises this pallindrome.
 (c) Name the enzyme that can link these two DNA fragments.

Ans. (a) 'a' – Vector DNA, (b) EcoRI (c) DNA ligase – 'b' – Foreign DNA.

SECTION—E

31. (A) Name and explain a surgical contraceptive method that can be adopted by the male partner of a couple.

5

Ans. One surgical contraceptive method that can be adopted by the male partner of a couple is a vasectomy.

Vasectomy is a permanent and safe contraception involving cutting / blocking the vas deferens, tube that carries sperm from the testicles to the penis. Thus the sperm is prevented from mixing with semen, making the man sterile.

The 30 minutes procedure is typically performed as an outpatient procedure under local anaesthesia.

During the procedure, one or two small incisions is made in the scrotum to cut or block the vas deferens.

Following this procedure, the man maybe advised to use other contraceptions for a few months until a semen analysis confirms no more viable sperm in it.

Vasectomy has a success rate of over 99%. However, being a permanent method of contraception it should only be considered by couples who are assured of not having children in the future.

Or

(B) (i) Write the specific location of the following in the testis in humans :

- (a) Sertoli cells
 (b) Leydig cells

(ii) Explain the coordination between gonadotropins, leydig cells and sertolli cells and their role in spermatogenesis.

Ans. (a) The specific location of the following cells in human testis are :

- (i) Sertoli cells - Sertoli cells are located within the seminiferous tubules of the testis.

- (ii) Leydig cells - Leydig cells are located in the interstitial space outside seminiferous tubules.

(b) A coordinated mechanism takes place between the gonadotropins, Leydig cells, Sertoli cells, during spermatogenesis as follows :

Spermatogenesis is the process of development of sperm cell in the male testis. The hypothalamus-pituitarygonadal axis regulates this process through the coordinated secretion of gonadotropins such as folliclestimulating hormone (FSH) that acts on the Sertoli cells and luteinizing hormone (LH) that acts on Leydig cells.

Sertoli cells nurture the developing sperm cells and regulate the local environment within the seminiferous tubules, for completing spermatogenesis.

They also synthesize androgen-binding protein (ABP), that binds to testosterone secreted by Leydig cells and delivers it to developing spermatogenic cells.

Leydig cells synthesize testosterone for developing and maturing sperm cells. Testosterone stimulates the precursor cells of sperm causing the proliferation and differentiation of spermatogonia. It also regulates the function of Sertoli cells and helps maintain the bloodtestis barrier, essential for the proper environment of spermatogenesis.

Attempt either option A or B

32. (A) (i) How does restriction endonuclease work ? 5

(ii) Galactosidase enzyme is considered a better selectable marker. Justify the statement or blunt ends.

Ans. (i) Restriction endonuclease enzymes are called molecular scissors which can cut double-stranded DNA at specific sites.

Role of restriction endonuclease

- (i) Restriction endonuclease inspects the length of DNA sequence.
 (ii) It finds specific recognition sequence, i.e. palindromic nucleotide sequence in DNA.
 (iii) These enzymes cut the strand of DNA a little away from centre of palindromic sites.

- (iv) Thus restriction endonucleases leave overhanging stretches called sticky ends on each strand.
- (ii) Recombinant strains can be differentiated from the nonrecombinants ones easily by using this selectable marker. The selection is done on the basis of the colour change. All are grown on a chromogenic substance. Non-recombinants will change from colourless to blue, while in recombinants insertional inactivation of b-galactosidase gene occurs. Attempt either option A or B Hence, recombinants show no colour change. This is a single step, easy method for selection.

Or

- (B) (i) How was insulin obtained before the advent of rDNA technology? What were the problems encountered ?**
- (ii) What are advantages of molecular diagnostic over conventional methods ?**

- Ans.** Before the advent of rDNA technology, insulin was obtained from pancreas of slaughtered cattle and pigs. Insulin derived from animal sources had the potential to induce allergic reactions or other adverse responses in certain patients due to the presence of foreign proteins.
- (ii) Advantages of molecular diagnostics
- (i) Early diagnosis is not possible using conventional methods, but by using rDNA technology, ELISA and PCR, early diagnosis is possible.
- (ii) It is also a powerful technique to identify many genetic disorders.
- (iii) It is used to detect mutations in genes in suspected cancer patients by the use of probes as markers.

- 33. (A) Differentiate between the following :**

- (a) mRNA and tRNA**
- (b) Template strand and coding strand.**

- Ans.** (a) Differences between mRNA and tRNA.

mRNA (messenger RNA)	tRNA (transfer or soluble RNA)
<p>1. It is the RNA which is a straight chain molecule.</p> <p>2. The nitrogenous bases (in the form of codons) code for the amino acids and decide the sequence of amino acids in a polypeptide.</p>	<p>1. This molecule becomes looped and assumes a clover leaf-like structure.</p> <p>2. This molecule has at one end a sequence of three bases called anticodon that is complementary to the codon for the particular amino acid it carries and transports.</p>

- (B) (i) Give examples of sex-linked inheritance in Drosophila.**

During his studies on genes in *Drosophila* that were sex-linked T.H. Morgan found F₂-population phenotypic ratios deviated from expected 9: 3: 3: 1. Explain the conclusion he arrived at.

- (ii) Briefly explain XX-XO (type of sex determination).**

- Ans.** (i) Examples of sex-linked inheritance in *Drosophila* (Morgan's conclusion).

- (a) Genes for white eye colour is located in the X-chromosome and Y-chromosome is empty carrying no normal allele for white eye colour.
- (b) The white eyed female possesses gene for white eye colour (W) on both of its X-chromosomes.
- (c) The white eyed males receive X-chromosome with (W) gene from mother and (Y) from father with no gene.
- (d) The daughter receives one X-chromosome with (W) gene from mother and one X-chromosome with dominant (W⁺)
- (ii) In case of round worms, true bugs, grasshoppers and cockroaches the females have two sex chromosomes XX, whereas the males have only one X-chromosome. The male have no second chromosome thus designated as XO. The sex ratio of 1:1 is produced as shown in figure below.

