

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)



Time Allowed: 3 Hours

Maximum Marks: 70

General Instructions

- (i) This question paper contains **33 questions**. All questions are compulsory.
- (ii) Section A: Questions 1 to 16 carry 1 mark each.
- (iii) Section B: Questions 17 to 21 carry 2 marks each.
- (iv) Section C: Questions 22 to 28 carry 3 marks each.
- (v) Section D: Questions 29 to 30 carry 4 marks each.
- (vi) Section E: Questions 31 to 33 carry 5 marks each.
- (vii) Attempt one alternative where an internal choice is provided. Follow the instructions within each question.
- (viii) Draw neat, properly labelled diagrams wherever necessary.

Section A

1. The region of chromatin that are actively transcribed are thought to be :

- (A) Heterochromatin (B) Euchromatin
(C) Scaffold chromatin (D) Solenoid chromatin

2. Given below are few statements with reference to the ovaries of the human female reproductive system :

- (i) It is 2 – 4 cm in length and is connected to the pelvic wall by tendons.
(ii) It is covered by a thin epithelium which encloses the ovarian stroma.
(iii) The stroma is divided into a peripheral medulla and an inner cortex.
(iv) The ovaries are the primary female sex organs that produce the female gamete (ovum).
(v) Ovaries are located one on each side of the lower abdomen.

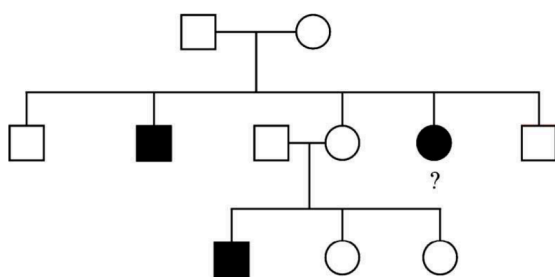
Choose the option with all true statements from the given options :

- (A) (i), (ii) and (iv) (B) (ii), (iii) and (v)
(C) (ii), (iv) and (v) (D) (i), (iii) and (iv)

3. The approach of sequencing the whole set of genome, including all the coding and non-coding sequences in HGP is :

- (A) Expressed Sequence Tags (B) Bioinformatics
(C) Sequence Annotation (D) DNA Polymorphism

4. In the pedigree chart given below, what should be the genotype of the indicated member ?



- (A) AA (B) Aa
(C) XY (D) aa

5. The lobed organ located near the heart and beneath the breast bone in humans is :

- (A) Liver (B) Spleen
(C) Thymus (D) Lungs

6. Unisexuality of flowers prevents which process ?

- (A) Both Geitonogamy and Xenogamy (B) Geitonogamy, but not Xenogamy
(C) Autogamy and Geitonogamy (D) Autogamy, but not Geitonogamy

7. Which of the following combinations is a correct example of convergent evolution in Placental mammals and Australian marsupials ? (columns: Placental Mammals -- Australian Marsupials)

- (A) Anteater — Lemur (B) Numbat — Bobcat
(C) Tasmanian tiger cat — Anteater (D) Lemur — Spotted cuscus

8. Isolation of DNA from a bacterial cell can be achieved by using :

- (A) Cellulase (B) Lysozyme
(C) Protease (D) Ribonuclease

9. Match the terms in Column-I with their description in Column-II and choose the correct option.

Column-I (Terms) — Column-II (Descriptions)

- a. Dominance — (i) Many genes govern a single character.
b. Codominance — (ii) In a heterozygote organism, only one allele expresses itself.
c. Pleiotropy — (iii) In a heterozygous organism, both alleles express themselves fully.
d. Polygenic inheritance — (iv) A single gene influences many characters.

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

10. Which enzyme(s) will be produced in a bacterial cell in which 'UAG' is inserted in the 'lac-y gene' due to mutation ?

Choose the correct option :

- | | |
|----------------------------|---|
| (A) Transacetylase | (B) Lactose permease |
| (C) β -galactosidase | (D) Lactose permease and transacetylase |

11. Large scale industrial production of citric acid for human welfare is done using the microbe :

- | | |
|-----------------------|---------------------|
| (A) Streptococcus sp. | (B) Aspergillus sp. |
| (C) Clostridium sp. | (D) Trichoderma sp. |

12. In a DNA, percentage of thymine is 20. What is the percentage of Guanine ?

- | | |
|---------|---------|
| (A) 20% | (B) 30% |
| (C) 40% | (D) 60% |

13. Assertion (A) : Gene pairs present on the same chromosome may be tightly linked or loosely linked.

Reason (R) : Frequency of recombination between gene pairs on different chromosomes as a measure of the distance between genes can be used for 'mapping' their position on the chromosomes.

- | | |
|--|---|
| (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). | (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). |
| (C) Assertion (A) is true, but Reason (R) is false. | (D) Assertion (A) is false, but Reason (R) is true. |

14. Assertion (A) : Cu-T, Cu-7 and LNG-20 are the most widely used copper-releasing IUDs.

Reason (R) : Cu-ions in IUDs effectively suppress sperm motility and the fertilising capacity of sperms.

- | | |
|--|---|
| (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). | (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). |
| (C) Assertion (A) is true, but Reason (R) is false. | (D) Assertion (A) is false, but Reason (R) is true. |

15. Assertion (A) : To generate only a part of the plant from a cell is totipotency.

Reason (R) : Suitable special nutrient media and sterile conditions are required in 'in vitro' conditions for the division of cells in explants.

- | | |
|--|---|
| (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). | (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). |
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16. Assertion (A): Lymphocytes arise from bone marrow and present in the blood and lymph and serve as natural killer cells.

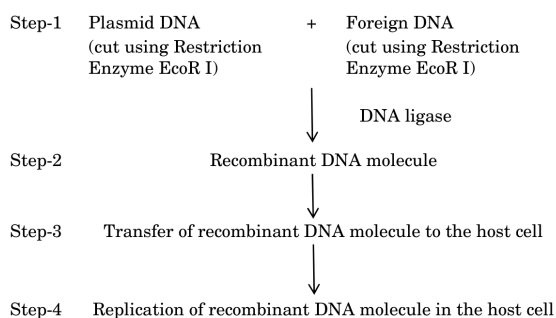
Reason (R): Lymphocytes migrate to thymus, where they develop into T-cells and begin to mature.

Select the correct answer from the codes given below :

- | | |
|--|---|
| (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). | (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). |
| (C) Assertion (A) is true, but Reason (R) is false. | (D) Assertion (A) is false, but Reason (R) is true. |

Section B

17. The basic scheme of the essential steps involved in the process of recombinant DNA technology is summarised below in the form of a flow diagram. Study the given flow diagram and answer the questions that follow :



- (a) Name the specific enzyme that might have been used to make the multiple copies of foreign DNA before undergoing Step-1 of the process.
- (b) How does the use of restriction enzyme EcoR I in Step-1 facilitate the action of DNA ligase to form the recombinant DNA molecule ? Explain.
- (c) Name the most commonly used host in the above process.

18(a). Explain what is meant by the term amniocentesis. How is this technique misused in India ?

OR

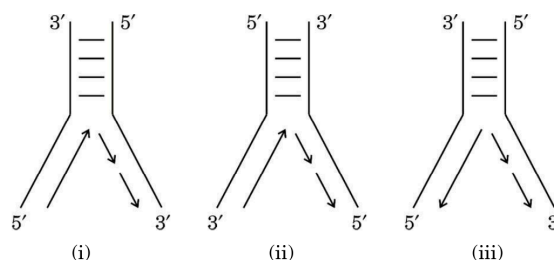
18(b). Name any two VD's which might occur in a human female. State any two complications in a female if it is left untreated.

19(a). Explain how the interaction between a fig tree and its tight one-to-one relationship with the pollinator species of wasp is one of the best examples of mutualism.

OR

19(b). Correctly depict (also indicate the trophic level) and describe the ecological pyramid of number with 32 birds dependent on 20 insects feeding on one banyan tree.

20. Given below are the diagrammatic representations of the replicating fork of DNA in *E. coli*. Study the diagrams and answer the questions that follow.



- (a) Which one of the three diagrams (i), (ii) or (iii) is the correct representation of the replicating fork of DNA replication ? Explain your answer.
- (b) Name the enzyme used in *E. coli* to join the newly synthesised fragments of DNA.

21(a). Give an account of the generalised structure of an antibody molecule produced by B-lymphocytes in response to the pathogen.

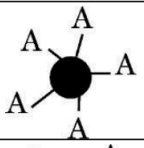
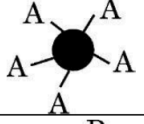
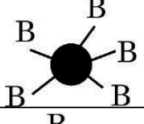
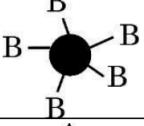
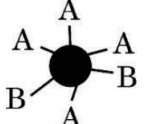
OR

21(b). Other than public awareness and counselling, enlist four measures taken up by NACO, WHO and other NGOs to prevent the spread of HIV infection in the society.

Section C

22. Explain how the loss of habitat and fragmentation drives plants and animals to extinction with the help of an example of habitat loss in the Tropical Rain Forest. Also write the effect of fragmentation of a habitat on the population decline.

23. Study the diagram of genotype, RBC and phenotype for ABO blood groups given below and answer the following questions :

Genotype	RBC	Phenotype
$I^A I^A$		A
$I^A i$		A
$I^B I^B$		B
$I^B i$		B
$I^A I^B$		AB
ii		O

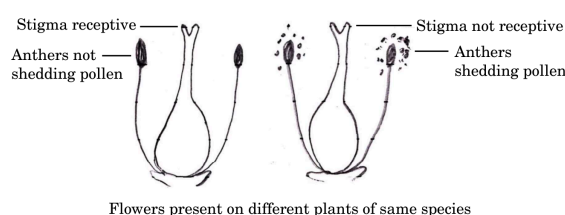
(a) How many alleles are involved in blood grouping ?

(b) A person having 'AB' blood group has both dominant alleles. What is this inheritance type called ?

(c) A man with 'A' blood group marries a woman with 'B' blood group. Can they have a child with 'O' blood group ? Explain with the help of a cross.

24. Explain the neuroendocrine mechanism involved in the process of parturition in a human female leading to the expulsion of the baby out of the uterus through the birth canal.

25. Many of the flowering plants producing hermaphrodite flowers have developed many devices to discourage self-pollination and to encourage cross-pollination. Given below is a picture of one such outbreeding device in a flowering plant. Study the picture and answer the questions that follow :



(a) Explain how the given type of pollination is advantageous to the plant.

(b) Can this flowering plant show geitonogamy ? Justify your answer.

26. Name a blood related autosomal Mendelian disorder. Why is it called as Mendelian disorder ? How is the disorder transmitted from parents to offspring ?

27. (a) Write the full form of BOD.

(b) Define BOD. Explain how it is a measure of the organic matter present in the water body.

28. Enlist three advantages of genetically modified plants.

OR

29. In 2021, 5.3 percent of 15 to 16-year-olds worldwide (13.5 million individuals) had used Cannabis in the past year according to UNODC. The adolescent brain is still developing and drug use can have long-term negative effects. Early drug use initiation can lead to faster development of dependence than in adults and other problems in adulthood. Parts of the Amazon Basin are at the intersection of multiple forms of organised crimes that are accelerating devastation, with severe implications for the security, health and well-being of the population across the region. The direct impact of coca cultivation on deforestation is minimal, but indirectly it acts as a catalyst for 'Narco-deforestation'. The laundering of drug trafficking profits into land speculation etc. is posing a growing danger to the world's largest rainforest.

- (a) Which age group or period of growth people are more vulnerable to drug abuse ?
- (b) Explain the negative impact of coca cultivation on the world's largest rainforest.
- (c) (i) From which part of the plant are cannabinoids mainly obtained ? Mention any one negative effect of this drug on adolescents.

29. In 2021, 5.3 percent of 15 to 16-year-olds worldwide (13.5 million individuals) had used Cannabis in the past year according to UNODC. The adolescent brain is still developing and drug use can have long-term negative effects. Early drug use initiation can lead to faster development of dependence than in adults and other problems in adulthood. Parts of the Amazon Basin are at the intersection of multiple forms of organised crimes that are accelerating devastation, with severe implications for the security, health and well-being of the population across the region. The direct impact of coca cultivation on deforestation is minimal, but indirectly it acts as a catalyst for 'Narco-deforestation'. The laundering of drug trafficking profits into land speculation etc. is posing a growing danger to the world's largest rainforest.

- (a) Which age group or period of growth people are more vulnerable to drug abuse ?
- (b) Explain the negative impact of coca cultivation on the world's largest rainforest.
- (c) (ii) State the scientific name of the plant from which coca alkaloids are derived and state one negative impact of use of excessive dosage of cocaine.

30. Highly conserved proteins such as Haemoglobin and Cytochrome-C provide the best biochemical evidences to trace evolutionary relationships between different groups. Cytochrome-C is formed of 104 amino acids. Cytochrome-C is the respiratory pigment present in all eukaryotic cells. It has evolved at a constant rate during evolution. In chimpanzees and humans, Cytochrome-C genes are identical. The given data shows the evolution of the Cytochrome-C gene in different mammals from kangaroos, cows, rodents to humans :

Groups	Nucleotide substitution in the gene of Cytochrome-C	Millions of years ago
Human/Kangaroo	100	125 mya
Human/Cow	75	120 mya
Human/Rodent	60	75 mya

- (a) Select the correct option for the time of separation of two groups and the number of nucleotide substitutions in the gene of Cytochrome-C : (i) Lesser — Greater (ii) Greater — Lesser (iii) Greater — Greater
- (b) What do you infer about the type of evolution (convergent or divergent) for the given pair of groups and why ? (i) Human and Kangaroo (ii) Human and Rodent
- (c) (i) Define convergent evolution.

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- (b) What do you infer about the type of evolution (convergent or divergent) for the given pair of groups and why ? (i) Human and Kangaroo (ii) Human and Rodent
- (c) (ii) Define divergent evolution.

Section E

- 31(a).** (i) Explain the structure of a typical monocotyledonous embryo of a flowering plant.
(ii) How are multiple embryos formed in a citrus fruit ? What is the mechanism known as ?

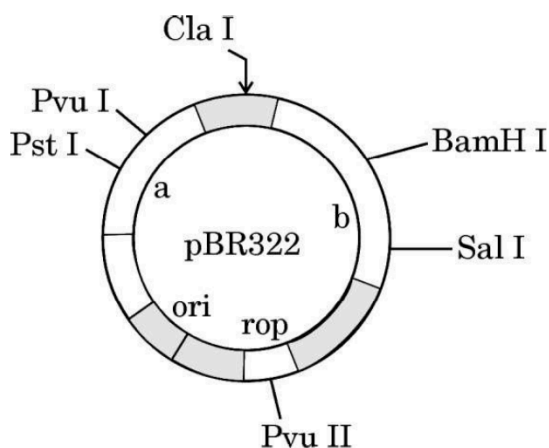
OR

- 31(b).** (i) Name and explain the structural organisation of the male sex accessory ducts in the human male reproductive system.
(ii) Describe the role of gonadotropin FSH in the regulation of spermatogenesis.

- 32(a).** (i) Explain why the insecticidal protein producing by *Bacillus thuringiensis* does not kill the bacteria itself.
(ii) How has man exploited this protein to produce cotton bollworm resistant Bt cotton plant ?

OR

- 32(b).** (i) Identify the selectable markers labelled as 'a' and 'b' in the given diagram of *E. coli* vector.



- (ii) How is coding sequence of enzyme β -galactosidase considered a better marker than the ones identified by you in the diagram ? Explain.
(iii) List any two uses of cloning vector in biotechnology.

- 33(a).** (i) Describe the population growth curve applicable in a population of any species in nature that has unlimited resources at its disposal.
(ii) Explain the equation of this growth curve.
(iii) Name the growth curve and depict a graphical plot for this type of population growth.

OR

- 33(b).** (i) Explain the conclusion drawn by Alexander von Humboldt during his extensive explorations in the wilderness of South American jungles.
(ii) Give the equation of the Species-Area relationship.
(iii) Draw a graphical representation of the relation between species richness and area for a wide variety of taxa such as birds, bats, etc.

- End of Question Paper -