

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. In *E. coli*, a DNA sequence that specifies where RNA polymerase will bind and initiate transcription of a gene is :

- (A) Start codon (B) Stop codon
(C) Terminator (D) Promoter

2. Given below are few statements with reference to the major events in the menstrual cycle of a human female :

- (i) During the follicular phase, the primary follicles grow to become a Graafian follicle.
(ii) Gonadotropins FSH and progesterone stimulate follicular development during the follicular phase.
(iii) LH surge induces rupture of Graafian follicle thereby releasing the corpus luteum.
(iv) Progesterone released by corpus luteum is essential for maintenance of endometrium.
(v) Both LH and progesterone attain a peak level in the middle of the cycle.

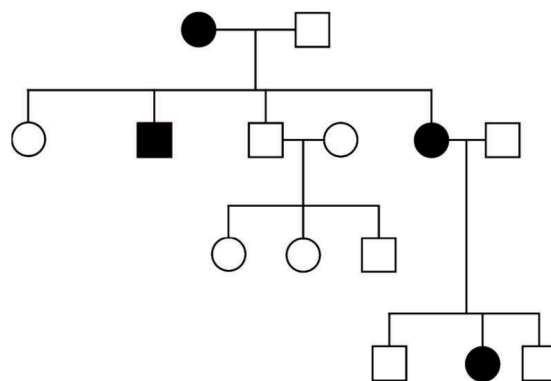
Choose the option with all true statements from the given options :

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

3. The approach used in HGP of identifying all the genes that are expressed as RNA is referred to as :

- (A) SNPs (B) YACs
(C) ESTs (D) BACs

4. Study the pedigree chart of a family showing the inheritance of myotonic dystrophy :



The trait under study is :

- (A) dominant X-linked trait (B) recessive X-linked trait
(C) autosomal dominant trait (D) autosomal recessive trait

5. The large bean-shaped organ acting as a filter of the blood in humans is :

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

6. Select the following statements that are true for insect pollinated flowers from the given options.

- (i) Majority of these flowers are large, colourful and rich in nectar.
- (ii) Nectars and seeds are usual floral rewards to attract insects for pollination.
- (iii) Pollen grains of these flowers are generally mucilaginous so as to stick to the body of the insects.
- (iv) A foul odour is emitted by some flowers to attract flies and beetles.

Choose the correct answer :

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

7. Which of the following combinations is a correct example of convergent evolution in Australian marsupials and Placental mammals ?

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

8. 'AGGTATCGCAT' is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed mRNA ?

- (A) AGGUAUCGCAU (B) ACCUAUGCGAU
- (C) UGGTUTCGCAT (D) UCCAUAGCGUA

9. Removal of RNA polymerase-III from nucleoplasm of a eukaryotic cell will affect the transcription of which of the following ?

- (A) tRNA (B) hnRNA
- (C) mRNA (D) rRNA

10. Large scale industrial production of streptokinase for human welfare is done using the microbe :

- (A) Streptomyces (B) Streptococcus
- (C) Streptobacilli (D) Streptopneumoniae

11. Isolation of DNA from a plant cell can be achieved by using :

- (A) Chitinase (B) Lysozyme
- (C) Cellulase (D) Pectinase

12. In a pea plant (*Pisum sativum*), green pod colour is dominant over yellow pod colour. The expected ratio of the phenotypes of the offsprings (F_1) in a cross between parents with heterozygous green pod colour and homozygous yellow pod will be :

- (A) 1 : 1 (B) 2 : 1
- (C) 3 : 1 (D) 4 : 1

13. Assertion (A) : Biogas plants are more often built in rural areas.

Reason (R) : The excreta or gober of cattle is rich in Methanobacterium.

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|--|---|
| (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. |
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14. Assertion (A): Mode of action of pills and implants/injectables is similar.

Reason (R): The effective period of pills is much longer as compared to implants/injectables.

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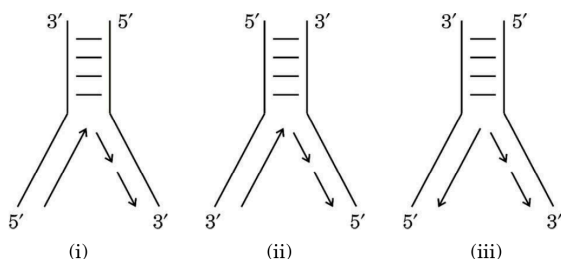
16. Assertion (A) : Gene pairs present on the same chromosome may be tightly linked or loosely linked.

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.

- | | |
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Section B

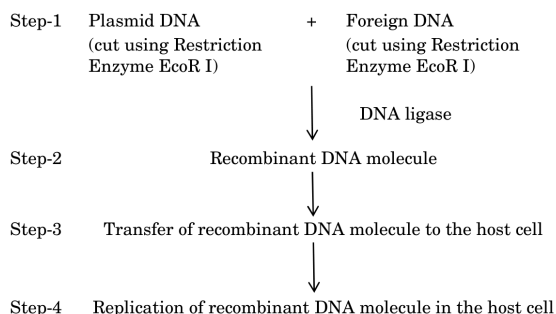
17. Given below are the diagrammatic representations of the replicating fork of DNA in *E. coli*. Study the diagrams and answer the questions that follow.



(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.

18. 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.

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

OR

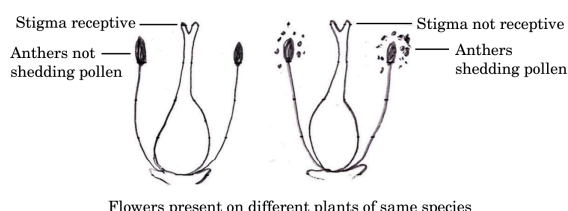
20(b). Name any two VDIs which might occur in a human female. State any two complications in a female if it is left untreated.

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.

22. 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.

23. Enlist three advantages of genetically modified plants.

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. Name one commonly occurring genetic disorder in humans which is caused due to monosomy (one chromosome less than the normal number of chromosomes) of sex chromosome. Give its two symptoms.

26. 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.

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. 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.

29. 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.

OR

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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.

30. 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.

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- (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.

Section E

31(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

31(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.

32(a). Explain how the process of RNA interference technology is used effectively to prevent infestation of the roots of tobacco plant by the nematode *Meloidogyne incognita*.

OR

32(b). Explain how more than a billion copies of a fragment of DNA are formed using the technique of PCR.

33(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

33(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.

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