

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 its extended 'beads-on-string' form of chromatin, the 'beads' are composed of :

- | | |
|---------------------------------|--|
| (A) Histones and linker DNA | (B) Histones and about 200 bp of DNA |
| (C) NHC proteins and linker DNA | (D) NHC proteins and about 200 bp of DNA |

2. Given below are few statements with respect to the process of oogenesis in a human ovary :

- (i) Each granulosa cell gets surrounded by a primary oocyte to form the primary follicle.
- (ii) A couple of million of oogonia are formed within each fetal ovary during the embryonic development.
- (iii) Tertiary follicle is characterised by antrum and theca layers.
- (iv) Secondary follicles form a zona pellucida layer around it.
- (v) Mature graafian follicle ruptures to release the secondary oocyte from the ovary.

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

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

3. The simplest definition of a gene in eukaryotes is - A unit of DNA that has information to mainly specify the synthesis of :

- | | |
|--|---|
| (A) Single polypeptide chain and mRNA only | (B) Many polypeptide chains and mRNA only |
| (C) Single polypeptide chain and functional RNA only | (D) Many polypeptide chains and functional RNA only |

4. A colourblind man marries a woman with normal sight who has no history of colourblindness in her family. What is the probability of their son being colourblind ?

- | | |
|---------|----------|
| (A) 0.5 | (B) 1 |
| (C) Nil | (D) 0.25 |

5. The type of antibodies produced during an immune response to allergens as dust and pollen grains in a person is :

- | | |
|---------|---------|
| (A) IgE | (B) IgA |
| (C) IgG | (D) IgD |

6. Select the statements that are true for a typical megasporangium of flowering plants.

- (i) It is attached to the placenta by hilum.
- (ii) It has a chalazal end that represents the basal part of the ovule.
- (iii) It has nucellus enclosed by integuments.
- (iv) Its micropylar end is known as chalazal.

Choose the correct answer :

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

7. The primates that probably lived in East Africa grasslands about two mya were :

- | | |
|------------------------|------------------|
| (A) Dryopithecus | (B) Ramapithecus |
| (C) Australopithecines | (D) Neanderthal |

8. Use the given information to select the amino acid attached to the 3' end of tRNA during the process of translation, if the coding strand of the structural gene being transcribed has the nucleotide sequence 'ATA'.

Codons for the amino acids :

UAU - Tyrosine

AUG - Methionine

AUA - Isoleucine

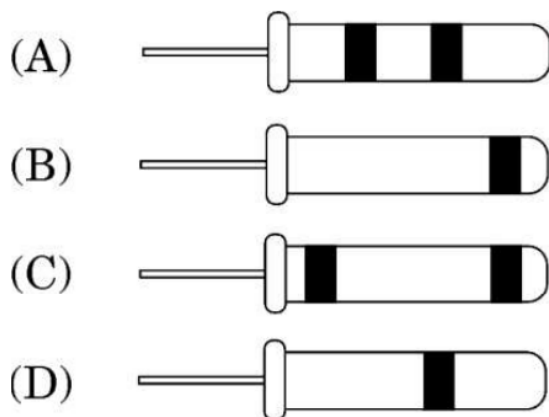
AGU - Serine

- | | |
|----------------|----------------|
| (A) Isoleucine | (B) Methionine |
| (C) Tyrosine | (D) Serine |

9. Early detection of HIV in suspected AIDS patients can be done using the diagnostic technique of :

- | | |
|-----------|----------|
| (A) ELISA | (B) PCR |
| (C) EST | (D) RNAi |

10. The correct depiction of the experiment performed by Matthew Meselson and Franklin Stahl to prove that DNA replicates semi-conservatively on separation of DNA by centrifugation after 40 minutes is :



- (A) Option A (B) Option B
(C) Option C (D) Option D

11. Large holes in 'Swiss cheese' are formed by the activity of microbes :

- (A) Streptococcus pneumoniae (B) Monascus purpureus
(C) Trichoderma polysporum (D) Propionibacterium sharmanii

12. In pea plant (*Pisum sativum*) axial flower position is dominant over terminal flower position. The expected ratio of phenotypes of the offspring in a cross between both the parents with heterozygous axial flower will be :

- (A) 3 : 1 (B) 2 : 1
(C) 1 : 1 (D) 1 : 0

13. Assertion (A) : 'Saheli', an oral contraceptive inhibits ovulation and increases phagocytosis of sperms.

Reason (R) : It is a non-steroidal preparation.

- (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) : The meristems are grown 'in vitro' to obtain virus-free plants from an infected plant.

Reason (R) : If the plant is infected with a virus, the roots and the stems are free of virus.

- (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) : ABO blood grouping in humans is an example of multiple allelism.

Reason (R) : More than two genes in a population govern the same character in ABO blood grouping in humans.

- (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.

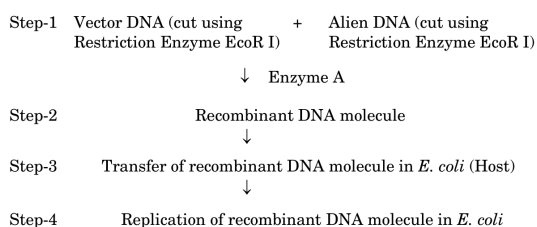
16. Assertion (A) : A person infected with malaria suffers from chill and high fever, recurring every three or four days.

Reason (R) : The parasite attacks the RBC resulting in their rupture and release of haemozoin.

- (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 summarized below in the form of a flow diagram. Study the given flow diagram and answer the questions that follow.



- (a) Name the enzyme used in Step-1 to join the cut plasmid and alien DNA.
- (b) State the technical term used for Step-3.
- (c) Justify the use of same Restriction Enzyme EcoR I to cut both the vector DNA and the alien DNA.

18(a). Explain how the interaction between sea anemone and clownfish is one of the best examples of commensalism in nature.

OR

18(b). Correctly depict (also indicate the trophic level) and describe the ecological pyramid of biomass in sea with 40 standing crop of phytoplankton supporting 90 standing crop of zooplankton which further supports 120 small fishes.

19. Assume that the given mRNA (start site is not depicted) is theoretically translated in two reading frames.

(a) Translation starting from the first nucleotide (Reading frame 1)

(b) Translation starting from the second nucleotide (Reading frame 2)

Frame 1

5' - CUCGCUUGCCGAUCAAGGGUUA - 3'

Frame 2

5' - GUGGCACUCAGUCCUUA AUGGCG - 3'

Answer the following question :

How many amino acids will be specified in case (a) and case (b) on translation ? Justify your answer.

20(a). Explain how the immunity of a person is affected if there is atrophy (degeneration) of the thymus gland at an early stage of life.

OR

20(b). (i) What are interferons ? Explain their role in providing immunity to a person.

(ii) Which category of innate immunity defence barrier can interferons be classified into ?

21(a). Write two features of an ideal contraceptive. Explain any one natural contraceptive method that makes the chances of conception almost nil.

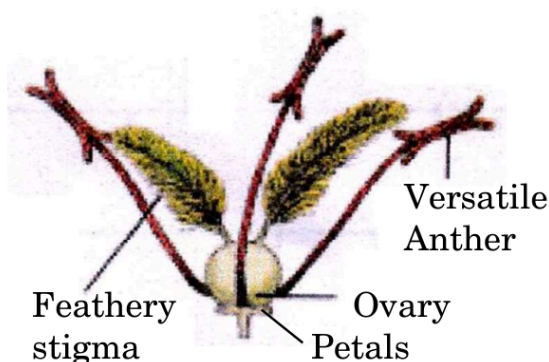
OR

21(b). Explain GIFT and ICSI.

Section C

22. Explain the biological treatment of primary effluent when passed into the large aeration tanks in a sewage treatment plant (STP).

23. Given below is a flower with its characteristic features specialised for the most common type of abiotic pollination.

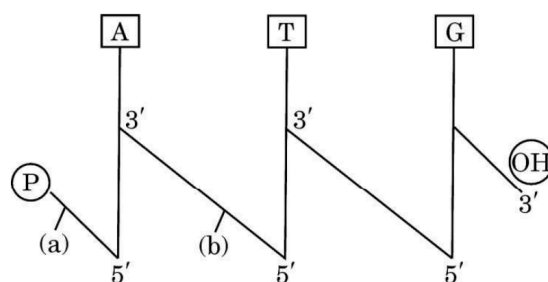


Answer the following questions based on the above diagram :

- Name the mode of abiotic pollination that will be adopted by the given plant species in the above picture.
- State the need of exposed large feathery stigmas for the flower.
- What will be the two important adaptations in the pollen grains of the flowers pollinated by the above mode of pollination ?
- What could be the probable reason for the petals being small and non-green ?

24. Enlist one advantage and two disadvantages of green revolution.

25. Study the given below single strand of deoxyribonucleic acid depicted in the form of a 'stick' diagram with 5' - 3' end directionality, sugars as vertical lines and bases as single letter abbreviations and answer the questions that follow.



- Name the covalent bonds depicted as (a) and (b) in the form of slanting lines in the diagram.
- How many purines are present in the given 'stick' diagram ?
- Draw the chemical structure of the given polynucleotide chain of DNA.

26. Thomas Hunt Morgan carried out several dihybrid crosses in *Drosophila melanogaster* to study genes that were sex linked.

(a) Give four major reasons for using the tiny fruit flies by Morgan for his experiments.

(b) How did Morgan and his group explain the physical association of the two genes on a chromosome to the frequency of recombination between gene pairs on the same chromosome ?

27. Explain the process of formation of placenta in a human female after the implantation of the blastocyst in the endometrium of the uterus.

28. According to a recent wildlife report, the biggest threat to the tiger's survival in Mudumalai Tiger Reserve (MTR) was found to be a small, beautiful flower, *Lantana camara*, a tropical American shrub, that invaded 40% of India's tiger range. Tamil Nadu department's *Lantana* weed eradication drive helped to restore the dying MTR thereby also reducing human-wildlife conflicts. MTR is home to 25 species of grasses and legumes.

Answer the given questions based on the information given above.

(a) Explain how did the removal of *Lantana* help in restoring the dying Mudumalai Tiger Reserve.

(b) Why is the invasion of *Lantana camara* a cause of concern in MTR.

29(a). Read the following passage and answer the questions that follow.

Deaths related to the use of drugs were estimated at about 5,00,000 in 2019, 17.5 percent more than in 2009. Liver diseases attributed to Hepatitis B are a major cause of drug-related deaths, according to UNODC, accounting for more than half of the total number of deaths attributed to the use of drugs. Drug overdoses account for a quarter of drug-related deaths.

Opioids contribute to account for the most severe drug-related harm, including fatal overdoses, when used non-medically. At the global level, two-third of direct drug-related deaths are due to opioids, and in some sub-regions the proportion can be as high as three-quarters of such deaths.

Why are people taking opioids more prone to liver diseases attributed to Hepatitis B ?

29(b). Read the following passage and answer the questions that follow.

Deaths related to the use of drugs were estimated at about 5,00,000 in 2019, 17.5 percent more than in 2009. Liver diseases attributed to Hepatitis B are a major cause of drug-related deaths, according to UNODC, accounting for more than half of the total number of deaths attributed to the use of drugs. Drug overdoses account for a quarter of drug-related deaths.

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What is meant by direct drug-related disease ?

29(c)(i). Read the following passage and answer the questions that follow.

Deaths related to the use of drugs were estimated at about 5,00,000 in 2019, 17.5 percent more than in 2009. Liver diseases attributed to Hepatitis B are a major cause of drug-related deaths, according to UNODC, accounting for more than half of the total number of deaths attributed to the use of drugs. Drug overdoses account for a quarter of drug-related deaths.

Opioids contribute to account for the most severe drug-related harm, including fatal overdoses, when used non-medically. At the global level, two-third of direct drug-related deaths are due to opioids, and in some sub-regions the proportion can be as high as three-quarters of such deaths.

What is the scientific name of the plant from which the opioids are derived and from which part of the plant is it extracted ?

OR

29(c)(ii). Read the following passage and answer the questions that follow.

Deaths related to the use of drugs were estimated at about 5,00,000 in 2019, 17.5 percent more than in 2009. Liver diseases attributed to Hepatitis B are a major cause of drug-related deaths, according to UNODC, accounting for more than half of the total number of deaths attributed to the use of drugs. Drug overdoses account for a quarter of drug-related deaths.

Opioids contribute to account for the most severe drug-related harm, including fatal overdoses, when used non-medically. At the global level, two-third of direct drug-related deaths are due to opioids, and in some sub-regions the proportion can be as high as three-quarters of such deaths.

State two common warning signs of drug abuse among the youth.

30(a). Read the following passage and answer the questions that follow.

The most convincing evidence to trace evolutionary relationships between humans and different groups of animals come from the basic similarities seen at the molecular level. Study the table given below that depicts the number of amino acid differences between the haemoglobin polypeptide of few animals with that of humans and answer the questions that follow.

S.No.	Animal	No. of amino acid differences in haemoglobin with that of humans
1.	Macaque	08
2.	Dog	32
3.	Bird	45
4.	Frog	67
5.	Lamprey	125

To which category of evolution (Divergent or Convergent) do the following evolutionary relationships belong to :

- (i) Humans and Macaque
- (ii) Humans and Frog

30(b). Read the following passage and answer the questions that follow.

The most convincing evidence to trace evolutionary relationships between humans and different groups of animals come from the basic similarities seen at the molecular level. Study the table given below that depicts the number of amino acid differences between the haemoglobin polypeptide of few animals with that of humans and answer the questions that follow.

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What do the biochemical similarities in haemoglobin suggest about the evolutionary relationship between humans, frog and lamprey ?

30(c)(i). Read the following passage and answer the questions that follow.

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4.	Frog	67
5.	Lamprey	125

Which one of the two - lampreys' or macaques' evolution is more closely related to humans and why ?

OR

30(c)(ii). Read the following passage and answer the questions that follow.

The most convincing evidence to trace evolutionary relationships between humans and different groups of animals come from the basic similarities seen at the molecular level. Study the table given below that depicts the number of amino acid differences between the haemoglobin polypeptide of few animals with that of humans and answer the questions that follow.

S.No.	Animal	No. of amino acid differences in haemoglobin with that of humans
1.	Macaque	08
2.	Dog	32
3.	Bird	45
4.	Frog	67
5.	Lamprey	125

Which one of the two - frogs' or dogs' evolution is more closely related to humans and why ?

Section E

31(a). (i) Describe the population growth curve applicable in a population of any species in nature that has limited resources at its disposal.

(ii) Give 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 Species-Area relationship within a natural forest and also predict the nature of graph when species richness is plotted against the area for a wide variety of taxa.

(ii) Depict the graphical relationship between species richness and area.

(iii) Give the equation of the Species-Area relationship for a wide variety of taxa on a logarithmic scale.

32(a). (i) Explain how does double fertilisation take place in a flowering plant.

(ii) Write the fate of the products of double fertilization in these plants.

OR

32(b). (i) Explain the structure of testicular lobules in human male reproductive system. Name the two types of cells present in the seminiferous tubules and state their role.

(ii) Describe the role of hypothalamic hormone GnRH in spermatogenesis.

33(a). (i) Name the two genes encoding for the Bt toxin protein used in biotechnology for the control of cotton bollworms.

(ii) How does the expression of Bt toxin gene in Bt cotton plant help in providing resistance to cotton bollworms ? Explain.

OR

33(b). (i) Explain the given methods of introducing the alien DNA in the host cells :

(I) Biolistics

(II) Microinjection

(ii) How is *E. coli* made 'competent' to take up a recombinant plasmid or DNA ?

- End of Question Paper -