

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)



Time Allowed: 3 Hours

Maximum Marks: 70

General Instructions

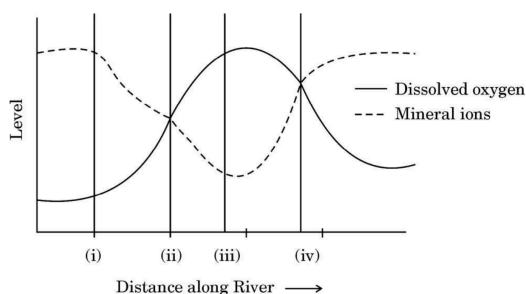
- (i) This question paper contains **33 questions**. All questions are compulsory.
- (ii) Section A: Questions 1 to 16 carry 1 mark each.
- (iii) Section B: Questions 17 to 21 carry 2 marks each.
- (iv) Section C: Questions 22 to 28 carry 3 marks each.
- (v) Section D: Questions 29 to 30 carry 4 marks 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. Three genes R, S and T are located on the same chromosome. If the recombinant percentage between R and S is 20%, R and T is 35% and S and T is 15% respectively, can you predict the correct order of these genes on the chromosome? Which of the following shows the correct sequence of the genes on the chromosome?

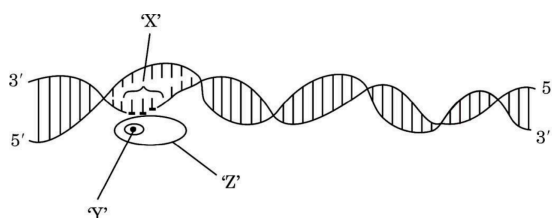
- (A) R-T-S (B) R-S-T
(C) S-R-T (D) S-T-R

2. The graph plotted below is based on the data collected by biology students with respect to the levels of oxygen at the specific points in the river flowing outside their city. Which point in the graph indicates the entry of untreated sewage in the river?



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

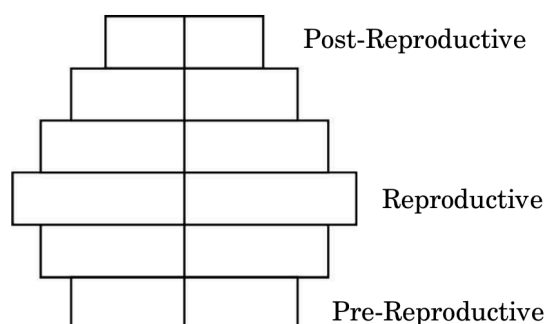
3. Identify the region 'X', the factor 'Y' and the enzyme 'Z' involved in the process of transcription in prokaryote as shown in the schematic representation given below.



Region 'X' | Factor 'Y' | Enzyme 'Z'

- (A) Terminator | Sigma (B) Promoter | Rho (ρ)
 (σ) | RNA | RNA polymerase
 polymerase
(C) Promoter | Sigma (D) Promoter | Sigma
 (σ) | RNA (σ) | DNA
 polymerase polymerase

4. The status of the human population reflected in the human age pyramid given below is :

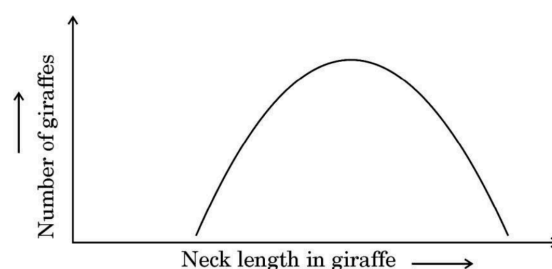


- (A) Declining population (B) Stable population
(C) Expanding population (D) Extinct population

5. Which one of the following products was produced as a result of DNA manipulation in the first transgenic cow 'Rosie'?

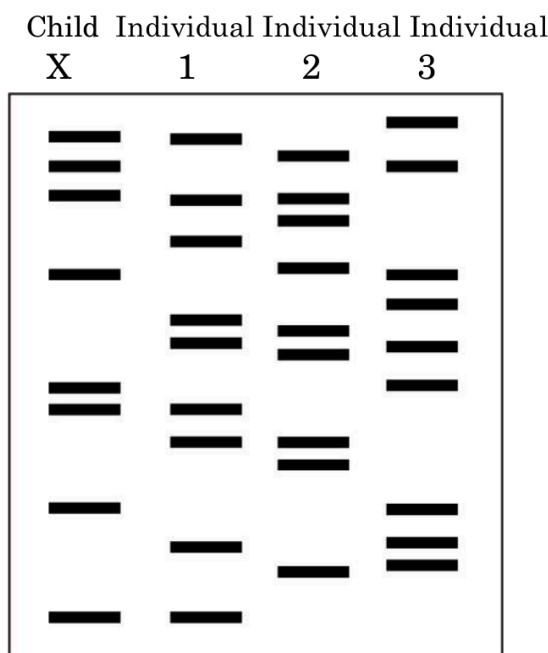
- (A) α -1-antitrypsin (B) α -lactalbumin
(C) β -lactglucose (D) α -deaminase

6. Select the option that gives the correct description of the process of Natural Selection with respect to the length of the neck of giraffe.



- (A) Stabilising selection as giraffes with longer neck lengths are selected further. (B) Disruptive selection as giraffes with smaller and longer neck lengths are selected.
(C) Directional selection as giraffes with longer neck lengths are selected. (D) Stabilising selection as giraffes with medium neck lengths are selected.

7. Study the DNA profiles obtained as a result of DNA fingerprinting of a child 'X' and three individuals 1, 2 and 3. Which one of the following options shows the possible parents of the child 'X' ?



- (A) 1 and 2 (B) 2 and 3
(C) 1 and 3 (D) Only individual 3

8. Choose the option that gives the correct number of pollen grains that will be formed after 325 microspore mother cells undergo microsporogenesis.

- (A) 325 (B) 650
(C) 1300 (D) 975

9. Given below are the steps carried out to construct a recombinant DNA. Which one of the following gives the correct sequence of these steps ?

- (i) Isolation of genetic material
(ii) Insertion of recombinant DNA in the host cell / organism
(iii) Obtaining the foreign gene product
(iv) Amplification of gene of interest
(v) Downstream processing

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

10. After the completion of biosynthetic stage in a bioreactor, the product undergoes a series of processes before it is ready for marketing. List of the processes is given below. Identify the option that gives the correct sequence of the processes carried out :

- (i) Purification of product
(ii) Formulation with suitable preservative
(iii) Separation of product
(iv) Clinical trial of product

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

11. Which of the following hormones is not secreted by the human placenta ?

- (A) Progesterone (B) Estrogen
(C) Human Chorionic Gonadotropin (HCG)
(D) Relaxin

12. Which of the following sexually transmitted disease is not caused by a virus ?

- (A) Genital herpes (B) Gonorrhoea
(C) Genital warts (D) Hepatitis-B
-

13. **Assertion (A):** Crystal protein Bt toxin does not kill the *Bacillus* but kills the insects.

Reason (R): Bt toxin exists in inactive form in *Bacillus* but when ingested by the insect, the acidic pH of its gut changes it into an active form.

- (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):** Endosperm is completely consumed during the development of embryo in ex-albuminous seeds.

Reason (R): Castor, pea and beans are all examples of ex-albuminous seeds.

- (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):** In an operon, the regulator and operator genes are not associated with the constitutive genes.

Reason (R): Constitutive genes need not be repressed.

- (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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16. **Assertion (A):** Cattle and goats are never seen browsing on *Calotropis* growing in abandoned fields.

Reason (R): Cattle and goats avoid grazing on *Calotropis* because of the offensive smell of its flowers.

- (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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Section B

17. From which end of the ovule, and how does the pollen tube gain its entry into the embryo sac of a *Hibiscus* flower ?

State the fate of the male nuclei present in the pollen tube.

18. India is the seventh largest country in the world in terms of total land area including land and water. Write the value of the land area of our country (in terms of percentage) of the world. Mention then, what makes India one of the 12 mega diversity countries of the world.

19(a). Vectors are DNA molecules that can carry a foreign DNA segment into the host cell.

(i) Write the significance of '*ori*' in this vector.

(ii) Give one example each of vectors used for cloning genes in plants and animals.

OR

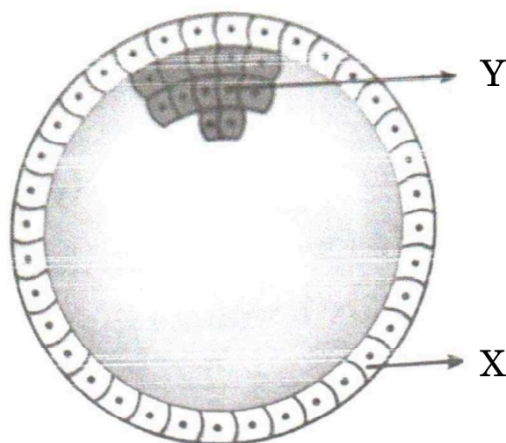
19(b). Write how can an alien DNA be introduced into

(i) an animal cell

(ii) a plant cell.

20. Plants capture only 2 - 10 percent of the photosynthetically active radiation of the Sun and this small amount of energy is able to sustain the entire living world. During this process, ecosystems are in consonance with the two laws of thermodynamics. Explain.

21. The diagram given below shows a developmental stage of human embryo. Answer the following questions with reference to it :



(a) Identify and name the human embryonic stage shown.

(b) Mention its exact location in the normal pregnancy of a woman.

(c) Write one function of each of the two parts labelled 'X' and 'Y'.

Section C

22. (a) Name the two primate ancestors of the present day humans, who existed approximately about 15 million years ago.

(b) According to geological records, when and where did *Australopithecines* live ?

(c) Give two differences between *Homo habilis* and *Homo erectus*.

23. (a) Differentiate between malignant and benign tumours.

(b) Name and explain the most feared property of a malignant tumour.

24. With the help of a schematic diagram only, show in three steps, the formation of recombinant DNA by the action of restriction endonuclease — *EcoRI* and DNA ligase.

25(a)(i). Expand the abbreviations given below, used for different modes of assisted reproductive technologies :

- (1) ZIFT
- (2) ICSI
- (3) IUT
- (4) GIFT

25(a)(ii). Which one of them cannot be considered as a procedure of IVF ? Give reasons in support of your answer.

OR

25(b). Differentiate between the following :

- (i) Perisperm and Pericarp
- (ii) Syncarpous pistil and Apocarpous pistil
- (iii) Plumule and Radicle

26. (a) Write the characteristics of 'stem cells'.

(b) From where can one obtain 'stem cells' in humans ?

(c) State any two applications of 'stem cells' in curing human diseases.

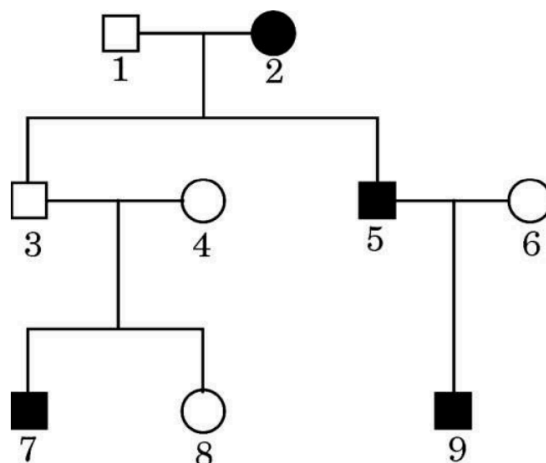
27. Treatment of wastewater is done in a sewage treatment plant to make it less polluting. Explain the following with reference to this treatment process :

(a) Primary sludge

(b) Activated sludge

(c) Anaerobic sludge digesters

28. Study the pedigree chart given below and answer the questions that follow :



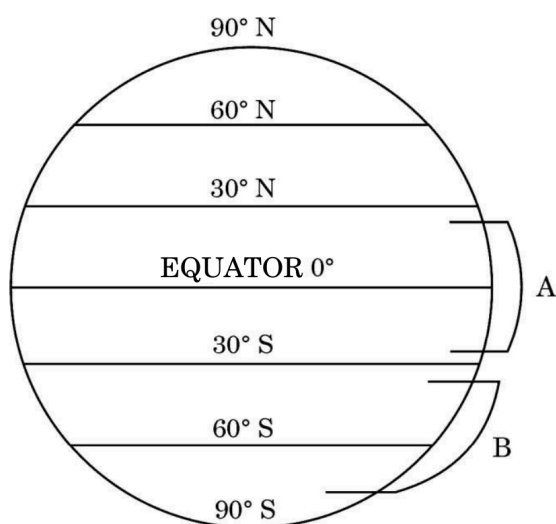
(i) Is this trait recessive or dominant ? Give reason.

(ii) Is this trait sex-linked or autosomal ? Give reason.

(iii) Among individuals 3, 4 and 7, which one is homozygous for the trait ?

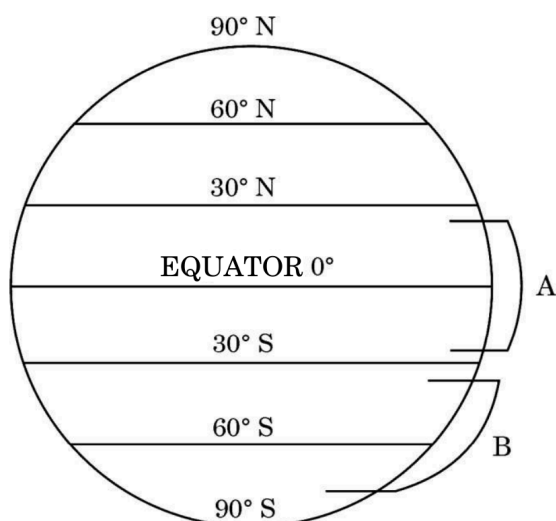
Section D

29(a). Study the diagrammatic representation given below of the Earth with regions marked 'A' and 'B' respectively. Answer the questions that follow.



Write the observations made regarding the species diversity when moving from region 'A' to region 'B'. Give two reasons also.

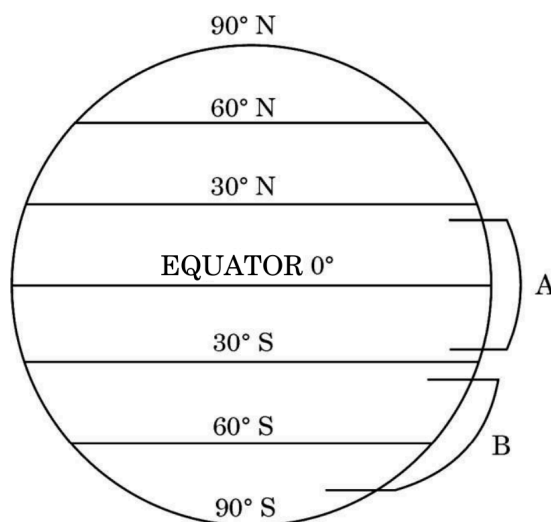
29(b). Study the diagrammatic representation given below of the Earth with regions marked 'A' and 'B' respectively. Answer the questions that follow.



Stating the reason, mention the approximate number of bird species recorded in India.

OR

29(b). Study the diagrammatic representation given below of the Earth with regions marked 'A' and 'B' respectively. Answer the questions that follow.



Name the region in the world that records the greatest biodiversity and mention why.

30(a). Gene expresses itself in a cell system as a protein/enzyme. How does an expression of gene occur in a cell system and when does it need to occur, and how the gene expression is regulated in a prokaryote cell system was studied by the combined efforts of Jacques Monod, the biochemist and Francois Jacob, the geneticist. For their work on lactose metabolism in *E. coli* and introducing the concept of "lac operon" they were awarded the Nobel Prize in 1965.

Why is lac operon said to be a transcriptionally regulated system ?

30(b). Gene expresses itself in a cell system as a protein/enzyme. How does an expression of gene occur in a cell system and when does it need to occur, and how the gene expression is regulated in a prokaryote cell system was studied by the combined efforts of Jacques Monod, the biochemist and Francois Jacob, the geneticist. For their work on lactose metabolism in *E. coli* and introducing the concept of "*lac* operon" they were awarded the Nobel Prize in 1965.

It is said that "the *lac* operon has to be operational at a very low level in the bacterial cell all the time." Justify.

30(c). Gene expresses itself in a cell system as a protein/enzyme. How does an expression of gene occur in a cell system and when does it need to occur, and how the gene expression is regulated in a prokaryote cell system was studied by the combined efforts of Jacques Monod, the biochemist and Francois Jacob, the geneticist. For their work on lactose metabolism in *E. coli* and introducing the concept of "*lac* operon" they were awarded the Nobel Prize in 1965.

Why is the regulator gene in *lac* operon marked as 'i' gene ?

30(d). Gene expresses itself in a cell system as a protein/enzyme. How does an expression of gene occur in a cell system and when does it need to occur, and how the gene expression is regulated in a prokaryote cell system was studied by the combined efforts of Jacques Monod, the biochemist and Francois Jacob, the geneticist. For their work on lactose metabolism in *E. coli* and introducing the concept of "*lac* operon" they were awarded the Nobel Prize in 1965.

Draw a schematic diagram of *lac* operon in absence of inducer in the culture medium of the bacteria.

OR

30(d). Gene expresses itself in a cell system as a protein/enzyme. How does an expression of gene occur in a cell system and when does it need to occur, and how the gene expression is regulated in a prokaryote cell system was studied by the combined efforts of Jacques Monod, the biochemist and Francois Jacob, the geneticist. For their work on lactose metabolism in *E. coli* and introducing the concept of "*lac* operon" they were awarded the Nobel Prize in 1965.

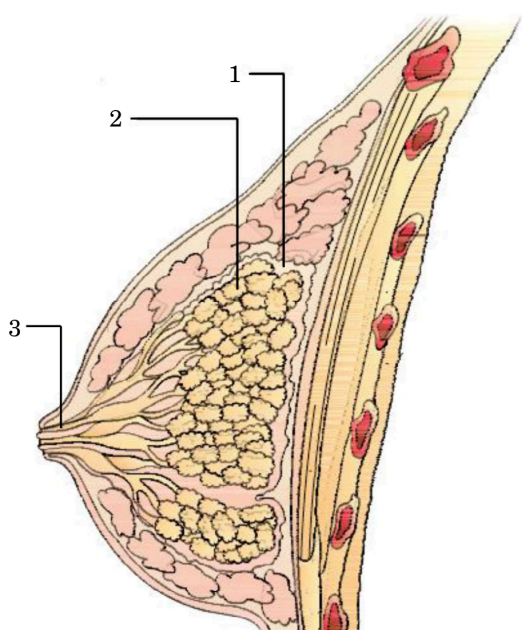
Draw a schematic diagram of *lac* operon in the presence of inducer in the culture medium of the bacteria.

Section E

31(a). (i) When and how does foetal ejection reflex begin ?

(ii) Pituitary gland and uterine muscles play an important role during parturition. Explain.

(iii) A functional mammary gland is a characteristic of all female mammals. Given below is a diagrammatic sectional view of a mammary gland. Identify the parts 1, 2 and 3, and mention one function of each of them.



OR

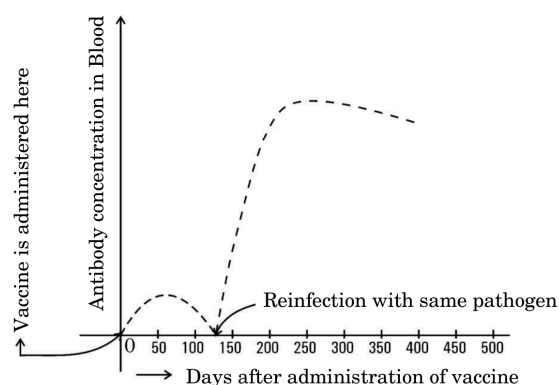
31(b). (i) How are the characteristic features of pollen, anther and stigma of a maize plant suited for pollination by wind ?

(ii) How do you justify that :

(1) Pollen grains are recovered from fossils ?

(2) Micropyle remains as a small pore in the seed coat of a fully developed seed ?

32(a). A time-bound vaccination programme is followed for the children in our country from their birth up to ten years of age. A graph plotted below shows the effect of the vaccination followed by infection by the same pathogen, and the antibody concentration in the blood of the child.



(i) Explain why the administration of a vaccine causes an increase in the antibody concentration.

(ii) If the child is infected with the same pathogen almost four months later, the antibody concentration in his/her blood increases very fast. Explain why.

(iii) A table given below gives information about different types of immunity and how they are attained. Identify 'P', 'Q', 'R', 'S' and 'T' in the table.

Type of immunity | Production of antibodies | Presence of memory cells | Mode attained

(1) Natural, active | Yes | 'P' | 'Q'

(2) Natural, passive | No | 'R' | Across the placenta during pregnancy/breast feeding

(3) Acquired, active | 'S' | Yes | Getting a vaccine during breast feeding

(4) Acquired, passive | 'T' | No | Getting an injection of antibodies

OR

32(b). (i) What is the chemical name of 'smack' ?
Why is the consumption of smack considered as an abuse ?

(ii) Name the source plant and one effect of the following drugs on the human body :

- (1) Marijuana
- (2) Cocaine
- (3) Morphine

33(a). Meselson and Stahl carried out an experiment to prove the nature of DNA replication. Recall the experiment and answer the following questions.

(i) Which two types of nitrogen were used by them in their experiment and why ?

(ii) Why did they take samples of *E. coli* at definite time intervals for their observation ?

(iii) State the role of caesium chloride density gradient in their experiment.

(iv) Write the conclusions they arrived at.

OR

33(b). (i) A true breeding tall pea plant with round seeds is crossed with a recessive dwarf pea plant having wrinkled seeds. Work out the cross up to F_2 generation giving the phenotypic ratios of F_1 and F_2 generation respectively.

(ii) State the Mendelian principle that can be derived only with the help of such a cross.

- End of Question Paper -