

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 ploidy of the apomictic embryos developing from the integument cells and synergids respectively would be :

- (A) n , $2n$ (B) $2n$, n
(C) $3n$, $2n$ (D) $2n$, $3n$

2. A DNA fragment has 2500 nucleotides, out of which 240 are Guanine. How many bases having double hydrogen bonds between them does this DNA fragment possess ?

- (A) 480 (B) 720
(C) 1010 (D) 2020

3. The mechanism to produce seeds without fertilisation has evolved in the given family of the flowering plants :

- (A) Asteraceae (B) Solanaceae
(C) Malvaceae (D) Liliaceae

4. Louis Pasteur dismissed the theory of spontaneous generation by his experiments using pre-sterilised flasks and :

- (A) Live yeast (B) Killed yeast
(C) Live bacteria (D) Killed bacteria

5. After the 1850s in the post-industrialization era in England, the expected effect of natural selection on the number of white-winged moths as compared to the dark-winged moths was :

- (A) Less in number (B) More in number
(C) Both were less in number (D) Both were more in number

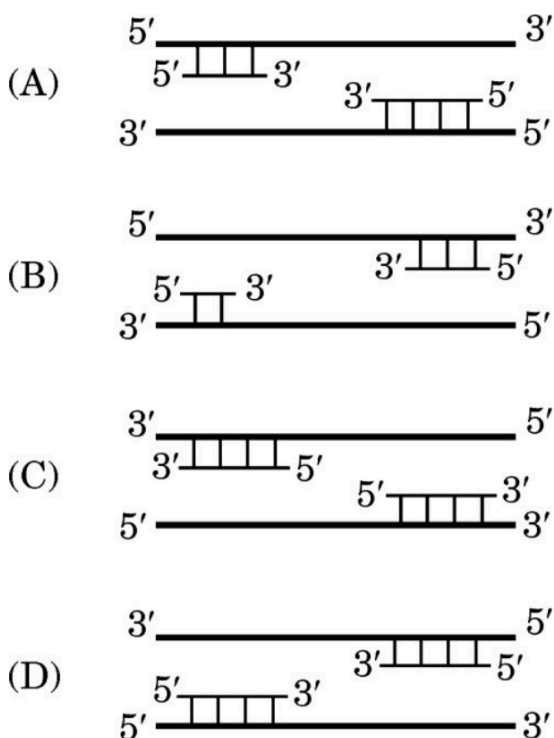
6. A Snapdragon plant bearing red colour flowers was crossed with a Snapdragon plant bearing white colour flowers. The F_1 progeny on selfing produced the progeny in the ratio of :

- (A) 50% Red : 50% White (B) 25% Pink : 50% White : 25% Red
(C) 50% Red : 50% Pink (D) 25% Red : 50% Pink : 25% White

7. In which of the following chromosomal disorders do individuals have short stature, underdeveloped feminine character and sterile ovaries ?

- (A) Down's syndrome (B) Turner's syndrome
(C) Klinefelter's syndrome (D) Patau's syndrome

8. Which one of the following represents the correct annealing of primers to the DNA to be amplified in the PCR?



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

9. A patient is suffering from fever, chills, cough, headache and bluish finger nails and lips. These symptoms are of the disease :

- (A) Malaria (B) Typhoid
(C) Common cold (D) Pneumonia

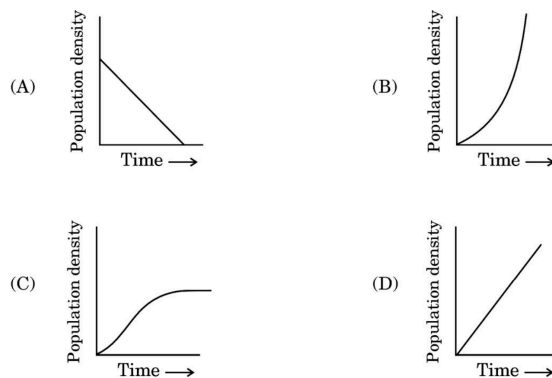
10. In an experiment, *E. coli* is grown in a medium containing $^{14}\text{NH}_4\text{Cl}$. (^{14}N is the light isotope of Nitrogen) followed by growing it for six generations in a medium having heavy isotope of nitrogen (^{15}N). After six generations, their DNA was extracted and subjected to CsCl density gradient centrifugation. Identify the correct density (Light/Hybrid/Heavy) and ratio of the bands of DNA in CsCl density gradient centrifugation.

- (A) Hybrid : Heavy, 1 : 16 (B) Light : Heavy, 1 : 31
(C) Hybrid : Heavy, 1 : 31 (D) Light : Heavy, 1 : 05

11. For the replication of the first recombinant DNA, Stanley Cohen and Herbert Boyer used the DNA polymerase of :

- (A) *Thermus aquaticus* (B) *Salmonella typhimurium*
(C) *Escherichia coli* (D) *Haemophilus influenzae*

12. The population growth curve applicable for a population growing in nature with limited resources available to them will be :



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

13. Assertion (A): The zygote gives rise to heart-shaped embryo and subsequently proembryo in most angiosperms.

Reason (R): The zygote is present at the micropylar end of the embryo sac and develops into an embryo.

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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14. Assertion (A): Primary transcripts in eukaryotes are subjected to splicing to remove the introns.

Reason (R): Primary transcripts contain both exons and introns and the introns are non-functional in eukaryotes.

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. |
-

15. Assertion (A): The stirrer facilitates the even mixing of oxygen availability in a bioreactor.

Reason (R): Stirred-tank bioreactors generally have a flat base.

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. |
-

16. Assertion (A): The chronic use of alcohol by a person leads to cirrhosis.

Reason (R): Alcohol addiction at times becomes the cause of mental and financial distress to the entire family of the addicted person.

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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Section B

17(a). Write important features of 'humus' formed during the decomposition cycle in a terrestrial ecosystem.

OR

17(b). (i) Graphically represent the relationship between species richness and area on a log-log scale for bats and fishes.

(ii) Write the equation for the relationship as on a logarithmic scale.

18. What is a vaccine? Write the basis on which it acts when administered in the body.

19. State the procedure followed in the technique of amniocentesis. List any two advantages of this technique.

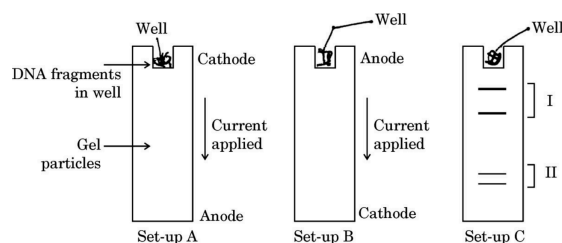
20. Consider the given data of a hypothetical small portion of mRNA that codes for a functional polypeptide chain and answer the questions that follow:

mRNA 5' – UCAUUACCACGAUUCUUUAAAAGA – 3'

(a) How many amino acids will be formed from the given codons, if substitution of 'U' by 'C' takes place at the 5th codon? Explain your answer.

(b) Write the number of amino acids that would be in the polypeptide synthesised by a similar mRNA as above, where in the fourth codon instead of 'C' there is 'U'. Justify your answer.

21. With reference to the set-ups (A, B and C) given below, of the electrophoretic separation of a mixture of DNA fragments of varied lengths, answer the questions that follow:



(a) In which one of the two Set-ups, A or B, would you see the DNA fragments separated and why? Justify your answer.

(b) In Set-up C, which one of the two, I/II, are the bands of longer fragments of DNA? Justify your answer.

Section C

22. (a) Draw a diagram of a human sperm. Label the following parts in it :

- (i) Which helps in the motility of the sperm
 - (ii) Which helps in penetrating through the corona radiata and zona pellucida
 - (iii) Which enters into the cytoplasm of the human egg
- (b) Mention how is polyspermy prevented during the course of fertilization in humans.

23(a). (i) List two major reasons for using cow-dung in a biogas plant instead of using domestic sewage.

(ii) Mention one use of the unspent slurry of the biogas plant.

OR

23(b). Name the bioactive molecule and its microbial source generally used by physicians to treat the patients for:

- (i) Myocardial infarction
- (ii) High blood cholesterol level
- (iii) Organ transplantation

24. Three crosses were carried out in pea plants with respect to flower colour violet/white (V/v) and flower position axial/terminal (A/a). Study in the table the crosses 'a', 'b' and 'c' where parental phenotypes and their F₁ progeny phenotypes are given.

Parental plants (Phenotypes)	F ₁ Progeny (Phenotypes)
(a) Violet, axial × white, axial	6/16 white, axial 2/16 white, terminal 6/16 violet, axial 2/16 violet, terminal
(b) Violet, axial × white, terminal	1/4 violet, axial 1/4 violet, terminal 1/4 white, axial 1/4 white, terminal
(c) Violet, axial × violet, axial	3/4 violet, axial 1/4 white, axial

Find the genotypes of each of the parental pairs of crosses 'a', 'b' and 'c'.

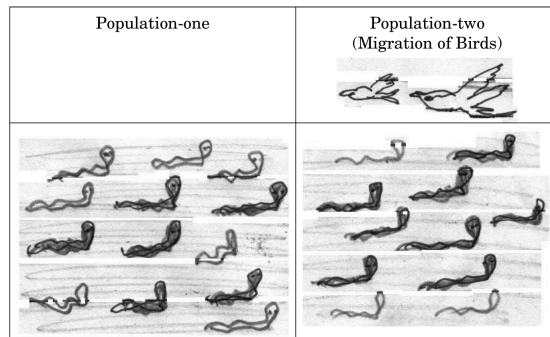
25. (a) Mention the advantages of 'ART'.
(b) Explain the 'ICSI' and 'AI' methods of assisted reproductive technologies.

26. (a) Give the scientific name of the bacteria widely used in biotechnology to create a GM cotton crop resistant to bollworm attacks.

(b) Explain how GM cotton crop is able to resist insect attacks.

27. Describe the mutualistic relationship that exists between the Mediterranean orchid *Ophrys* and a bee species.

28. A population of snakes lived in a desert with brown sand. Study the drawings given below showing the change in the population from 'one' to 'two' over time and answer the question that follows. Brown snakes and Grey snakes are represented by alleles A/a (Dominant/recessive).

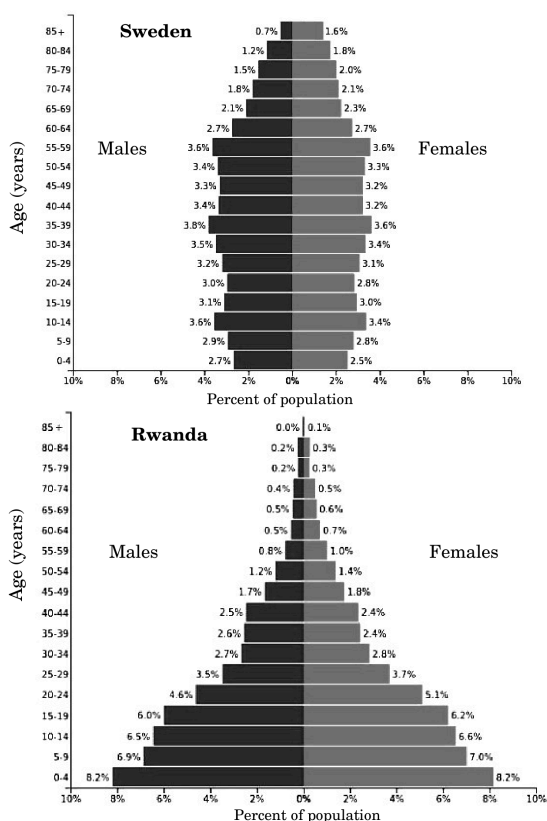


(a) If the frequency of the recessive trait is 9% in population-one, work out the frequency of homozygous dominant and heterozygous dominant snakes.

(b) Name the mechanism of evolution that must have operated so that population-two evolved from population-one.

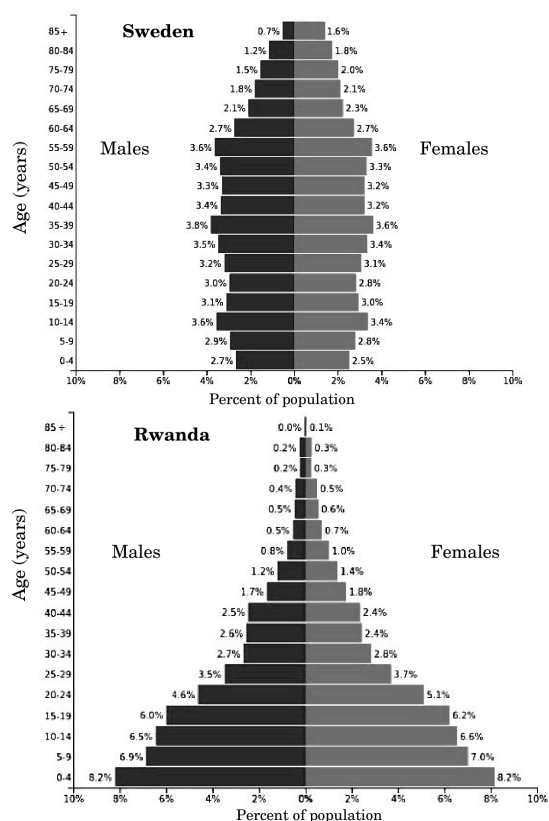
Section D

29(a). Study the figures given below that depict the comparative age distribution of human populations in Sweden and Rwanda. (International Data Base 2003) and answer the questions that follow.



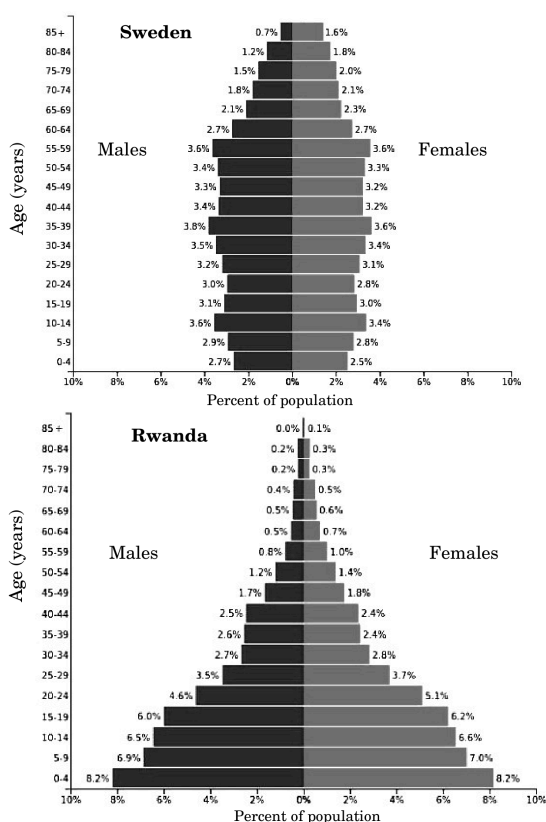
What can be inferred from the very broad base of Rwanda's age pyramid? Support your answer with the data provided in the figure.

29(b). Study the figures given below that depict the comparative age distribution of human populations in Sweden and Rwanda. (International Data Base 2003) and answer the questions that follow.



Sweden has an age distribution that is approximately of the same width near its base as at the apex. What does this indicate?

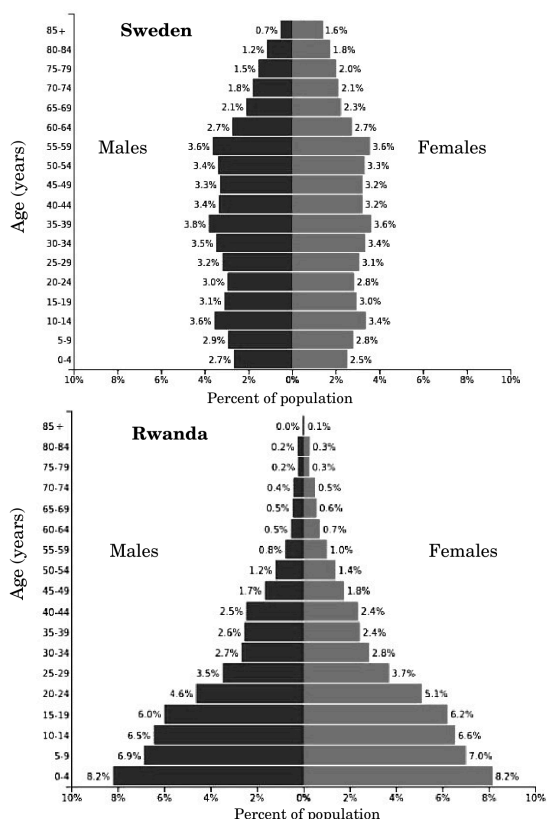
29(c). Study the figures given below that depict the comparative age distribution of human populations in Sweden and Rwanda. (International Data Base 2003) and answer the questions that follow.



Name the type of age pyramid shown above for Sweden.

OR

29(c). Study the figures given below that depict the comparative age distribution of human populations in Sweden and Rwanda. (International Data Base 2003) and answer the questions that follow.



Name the type of age pyramid shown above for Rwanda.

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

In recombinant DNA technology, restriction enzymes are used as they recognize and cut DNA within a specific recognition sequence. BamH I is one such restriction enzyme which binds at the recognition sequence 5' G-G-A-T-C-C 3' and cleaves this sequence between G and G on each strand, whereas AluI binds at the recognition sequence 5' A-G-C-T 3' and cleaves these sequences between G and C on each strand.

If AluI is used to cut the given DNA strand, how many DNA fragments would be formed? Write the sequence of each fragment formed with its polarity.

5' C-C-G-T-A-G-C-T-A-T-C-A-G-C-T-G-G 3'
3' G-G-C-A-T-C-G-A-T-A-G-T-C-G-A-C-C 5'

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

In recombinant DNA technology, restriction enzymes are used as they recognize and cut DNA within a specific recognition sequence. BamH I is one such restriction enzyme which binds at the recognition sequence 5' G-G-A-T-C-C 3' and cleaves this sequence between G and G on each strand, whereas AluI binds at the recognition sequence 5' A-G-C-T 3' and cleaves these sequences between G and C on each strand.

5' C-C-G-T-A-G-C-T-A-T-C-A-G-C-T-G-G 3'
3' G-G-C-A-T-C-G-A-T-A-G-T-C-G-A-C-C 5'

Which one of the two restriction enzymes BamH I or Alu I will preferably be used on the same given DNA strand to make a recombinant DNA molecule and why?

30(c). Read the passage given below and answer the questions that follow.

In recombinant DNA technology, restriction enzymes are used as they recognize and cut DNA within a specific recognition sequence. BamH I is one such restriction enzyme which binds at the recognition sequence 5' G-G-A-T-C-C 3' and cleaves this sequence between G and G on each strand, whereas AluI binds at the recognition sequence 5' A-G-C-T 3' and cleaves these sequences between G and C on each strand.

After binding to the two strands of the double helix DNA, where specifically does the restriction enzyme act to cut the two strands of DNA? Write the specific term used for the specific nucleotide sequences of DNA recognised by a restriction endonuclease.

OR

30(c). Read the passage given below and answer the questions that follow.

In recombinant DNA technology, restriction enzymes are used as they recognize and cut DNA within a specific recognition sequence. BamH I is one such restriction enzyme which binds at the recognition sequence 5' G-G-A-T-C-C 3' and cleaves this sequence between G and G on each strand, whereas AluI binds at the recognition sequence 5' A-G-C-T 3' and cleaves these sequences between G and C on each strand.

Write the specific sequence of DNA segment recognised by the restriction endonuclease EcoRI.

Section E

31(a). (i) Describe the life cycle of Plasmodium from the time it enters the human body till a female Anopheles mosquito bites an infected person.

(ii) Mention the two events of Plasmodium life cycle that occur within the female Anopheles body.

OR

31(b). (i) Write two differences between malignant tumor and benign tumor.

(ii) Explain any three diagnostic techniques for the detection of cancer.

32(a). (i) Explain any four devices that flowering plants have developed to encourage cross-pollination.

(ii) Why do plants discourage self-pollination? State any one reason.

OR

32(b). Explain the ovarian and uterine events taking place along with the role of pituitary and ovarian hormones, during menstrual cycle in a normal human female under the following phases:

(i) Follicular phase/proliferative phase

(ii) Luteal phase/secretory phase

(iii) Menstrual phase

33(a). "The influence of both the alleles in a heterozygous state is clearly expressed in codominance." Explain with the help of inheritance of ABO blood group in humans.

OR

33(b). "A group of genes are regulated and expressed together as a unit in lac operon."

(i) Explain the mechanism of switching 'on' of the structural genes of lac operon.

(ii) "Regulation of 'lac operon' is referred to be negatively regulated." Justify giving a reason.

- End of Question Paper -