

General Instructions :

Read the following instructions very carefully and strictly follow them :

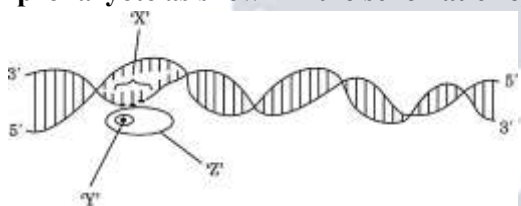
- (i) This question paper contains 33 questions. All questions are compulsory.
- (ii) Question paper is divided into FIVE sections - Section A, B, C, D and E.
- (iii) In Section A - question number 1 to 16 are Multiple Choice (MCQ) type questions carrying 1 mark each.
- (iv) In Section B - question number 17 to 21 are Very Short Answer (VSA) type questions carrying 2 marks each.
- (v) In Section C - question number 22 to 28 are Short Answer (SA) type questions carrying 3 marks each.
- (vi) In Section D - question number 29 and 30 are case-based questions carrying 4 marks each. Each question has subparts with internal choice in one subpart.
- (vii) In Section E - question number 31 to 33 are Long Answer (LA) type questions carrying 5 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 2 questions in Section D and 1 question in Section E. A candidate has to attempt only one of the alternatives in such questions.
- (ix) Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION - A

1. Which one of the following processes results in the production of recombinants in future generations?

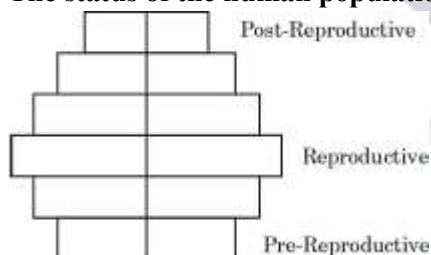
- (i) Mutation
 - (ii) Independent assortment during meiosis I
 - (iii) Independent assortment during meiosis II
 - (iv) Crossing over of bivalents
- (a) (iv) only (b) (ii) and (iv)
(c) (i), (ii) and (iii) (d) (i), (ii), (iii) and (iv)

2. 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.

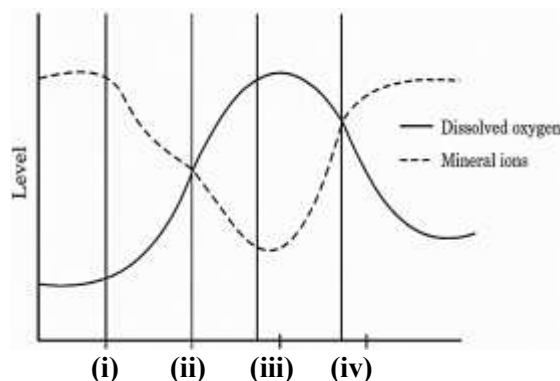


- | Region 'X' | Factor 'Y' | Enzyme 'Z' |
|----------------|--------------------|----------------|
| (a) Terminator | Sigma (σ) | RNA polymerase |
| (b) Promoter | Rho (ρ) | RNA polymerase |
| (c) Promoter | Sigma (σ) | RNA polymerase |
| (d) Promoter | Sigma (σ) | DNA polymerase |

3. 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
4. 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?



Distance along River →

- (a) Point (i) (b) Point (ii)
(c) Point (iii) (d) Point (iv)

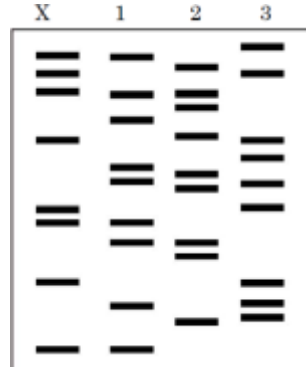
5. Given below are two columns. In Column I is the list of four enzymes and in Column II is the list of functions of the given enzymes. Which one of the following options shows the enzymes matched with their respective functions correctly?

Column I (Enzyme)		Column II (Function)	
(P)	DNA Ligase	(I)	Removes nucleotides from ends of DNA
(Q)	Restriction exonuclease	(II)	Extends primer on a DNA template
(R)	Taq polymerase	(III)	Joins the DNA fragments
(S)	Restriction endonuclease	(IV)	Cuts DNA at a specific position

- (a) (P)-(I), (Q)-(II), (R)-(IV), (S)-(III)
(b) (P)-(IV), (Q)-(III), (R)-(II), (S)-(I)
(c) (P)-(I), (Q)-(IV), (R)-(III), (S)-(II)
(d) (P)-(III), (Q)-(I), (R)-(II), (S)-(IV)

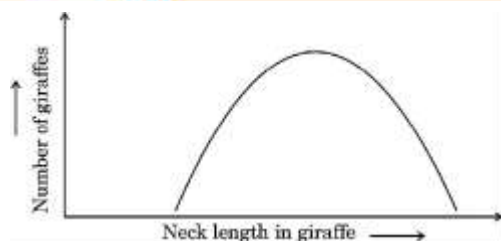
6. Study the DNA profiles obtained as a result of DNA fingerprinting of a child 'X' and three individuals 1, 2 and 3. Which one of the following options shows the possible parents of the child 'X'?

Child Individual Individual Individual



- (a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) Only individual 3

7. 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.

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 two columns. In Column I the names of four contraceptive devices are given and in Column II the modes of action of the contraceptives are given. Select the option where the contraceptive devices are correctly matched with their respective modes of action.

Column I (Contraceptive devices)		Column II (Modes of action)	
(P)	Lippes loop	(I)	Inhibition of ovulation
(Q)	Multiload 375	(II)	Phagocytosis of sperms in uterus
(R)	Subcutaneous Norplant	(III)	Causes thickening of cervical mucous
(S)	Saheli	(IV)	Makes cervix hostile to sperms

- (a) (P)-(II), (Q)-(IV), (R)-(III), (S)-(I)
 (b) (P)- (I), (Q)- (II), (R)- (III), (S)- (IV)
 (c) (P)- (III), (Q)- (I), (R)- (IV), (S)- (II)
 (d) (P)- (IV), (Q)- (III), (R)- (II), (S)- (I)

10. In which one of the following options does the endocrine gland correctly match with its hormonal secretion and its function?

	Endocrine Gland	Hormone	Function
(a)	Sertoli cells	Testosterone	Development of secondary sexual characteristics
(b)	Placenta	Estrogen	Initiates secretion of milk
(c)	Leydig cells	Androgen	Initiates the production of sperms

(d)	Ovary	FSH	Stimulates follicular development
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11. The organism used in construction of the first artificial recombinant DNA by Cohen and Boyer in 1972 was:

- (a) E. coli
- (b) Salmonella typhimurium
- (c) Agrobacterium tumefaciens
- (d) Bacillus thuringiensis

12. Who among the following challenged the patent right granted to the University of Mississippi Medical Centre for 'use of turmeric in wound healing'?

- (a) Mr. Ajay Phadke
- (b) Ms. Vandana Shiva
- (c) Dr. Venugopalan
- (d) Dr. R.A. Mashelkar

For Questions number 13 to 16, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as 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.

13. **Assertion (A)** : A patient of ADA deficiency undergoing treatment for gene therapy requires periodic infusion of genetically engineered lymphocytes.

Reason (R) : Lymphocytes are immortal.

14. **Assertion (A)** : A cattle egret and grazing cattle in close association is a classic example of commensalism.

Reason (R) : As grazing cattle move through the field, they stir up and flush out insects from the vegetation that otherwise might be difficult for egrets to find and catch.

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

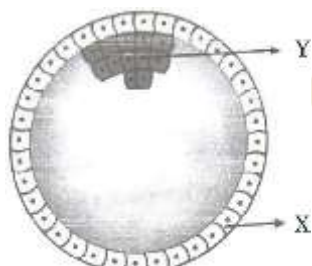
Reason (R) : Castor, pea and beans are all examples of ex-albuminous seeds.

16. **Assertion (A)** : Birds like pigeon have heterogametic females whereas the males are homogametic.

Reason (R) : In pigeons, females have Z and W sex chromosomes whereas males have ZZ sex chromosomes.

SECTION B

17. 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.

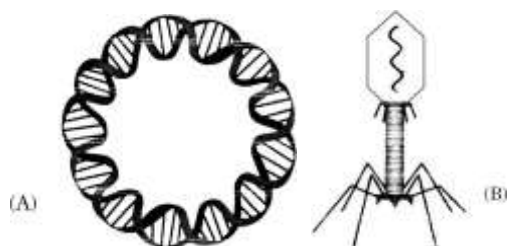
(B) Mention its exact location in the normal pregnancy of a woman.

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

18. (A) From which end of the ovule, and how does the pollen tube gain its entry into the embryo sac of a Hibiscus flower?

(B) State the fate of the male nuclei present in the pollen tube.

19. (A) (i) Identify and name the structures 'A' and 'B' marked in the image given below :



(ii) State their importance in various biotechnology experiments.

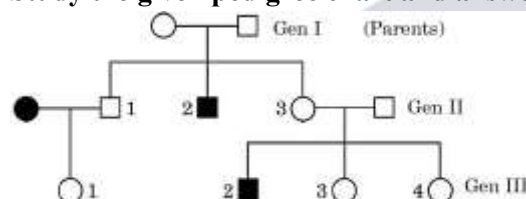
OR

(B) Explain the process by which a bacterial cell can be made 'competent' to take up foreign DNA from its surroundings, using divalent cations and temperature treatment.

20. Ecological pyramids give important information about the ecological system, but do have some limitations. List any two limitations of ecological pyramids.
21. 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.

SECTION C

22. 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.
23. Study the given pedigree chart and answer the questions that follow.



- (A) Is the trait given in the chart dominant or recessive ? Give reason in support of your answer.
- (B) Is this trait autosomal or sex-linked ? Give reason in support of your answer.
- (C) Write the possible genotypes of the children numbers '1' and '3' of the second generation.
24. (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.
25. (A) Differentiate between malignant and benign tumours.
- (B) Name and explain the most feared property of a malignant tumour.
26. 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
27. (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.
28. (A) (i) Expand the abbreviations given below, used for different modes of assisted reproductive technologies:
- (1) ZIFT
 - (2) ICSI
 - (3) IUT
 - (4) GIFT
- (ii) Which one of them cannot be considered as a procedure of IVF ? Give reasons in support of your answer.
- OR
- (B) Differentiate between the following :
- (i) Perisperm and Pericarp

- (ii) Syncarpous pistil and Apocarpous pistil
- (iii) Plumule and Radicle

SECTION D

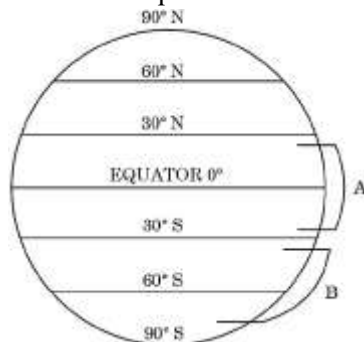
29. Gene expresses itself in a cell system as a protein/enzyme. How does an expression of gene occur in a cell system and when does it need to occur, and how the gene expression is regulated in a prokaryote cell system was studied by the combined efforts of Jacques Monod, the biochemist and Francois 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.

- (A) Why is lac operon said to be a transcriptionally regulated system ?
- (B) It is said that "the lac operon has to be operational at a very low level in the bacterial cell all the time." Justify.
- (C) Why is the regulator gene in lac operon marked as 'i' gene ?
- (D) Draw a schematic diagram of lac operon in absence of inducer in the culture medium of the bacteria.

OR

(D) Draw a schematic diagram of lac operon in the presence of inducer in the culture medium of the bacteria.

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



- (A) Write the observations made regarding the species diversity when moving from region 'A' to region 'B'. Give two reasons also.
- (B) Stating the reason, mention the approximate number of bird species recorded in India.

OR

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

SECTION E

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

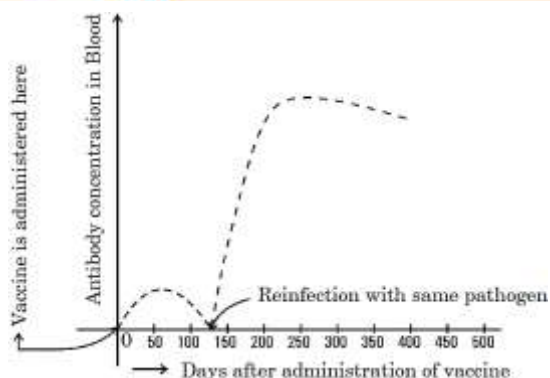
- (i) Which two types of nitrogen were used by them in their experiment and why?
- (ii) Why did they take samples of *E. coli* at definite time intervals for their observation?
- (iii) State the role of caesium chloride density gradient in their experiment.
- (iv) Write the conclusions they arrived at.

OR

(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.

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.



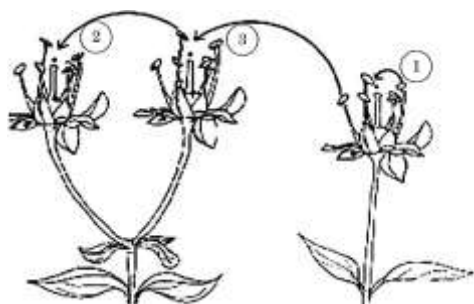
- (i) Explain why the administration of a vaccine causes an increase in the antibody concentration.
- (ii) If the child is infected with the same pathogen almost four months later, the antibody concentration in his/her blood increases very fast. Explain why.
- (iii) A table given below gives information 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

- (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

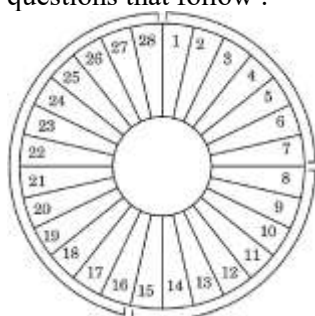
33. (A) Study the diagram given below showing the modes of pollination. Answer the questions that follow.



- (i) The given diagram shows three methods of pollen transfer in plants. What are the technical terms used for pollen transfer methods '1', '2' and '3'?
- (ii) How do the following plants achieve pollination successfully?
- (1) Water lily
 - (2) Vallisneria
- (iii) Flowering plants have developed many devices to avoid inbreeding depression. Explain one hereditary and one physiological device which helps plants to achieve this target.

OR

- (B) Observe the diagram given below showing the menstrual cycle of a normal human female and answer the questions that follow :



Numbers indicate the days of the menstrual cycle

- (i) What are the suitable technical terms used for the following?
- (1) Days 1-7
 - (2) Days 8-12
 - (3) Days 16-28
 - (4) Days 13 - 15
- (ii) Explain the role of ovarian and pituitary hormones during the following time periods :
- (1) Days 8-12
 - (2) Days 13 - 15
 - (3) Days 16-28

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- (vi) In Section D - question number 29 and 30 are case-based questions carrying 4 marks each. Each question has subparts with internal choice in one subpart.
- (vii) In Section E - question number 31 to 33 are Long Answer (LA) type questions carrying 5 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 2 questions in Section D and 1 question in Section E. A candidate has to attempt only one of the alternatives in such questions.
- (ix) Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION - A

34. Choose the set of sex determining chromosomes that indicates the correct sex of the respective organism.

- (a) Homozygous sex chromosomes (ZZ) determine female sex in birds
- (b) XO type of sex chromosomes determine male sex in grasshoppers

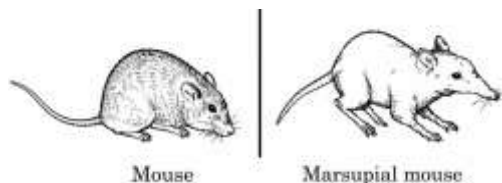
- (c) XXY condition in humans, as found in Turner Syndrome, determines male sex
(d) Homozygous sex chromosomes (XX) produce male sex in Drosophila

35. Given below is a list of steps Meselson and Stahl carried out in their experiment to prove that DNA replication is semi-conservative. Select the option that gives the correct sequence of steps followed by them.

- (I) Bacteria transferred to a N^{14} medium and sampled every 20 minutes.
(II) All bacteria contain hybrid DNA (N^{14} DNA and N^{15} DNA).
(III) Bacteria grown in N^{15} medium for many generations.
(IV) All bacteria contain N^{15} DNA.
(V) Bacteria contain either all N^{14} DNA or all hybrid DNA.

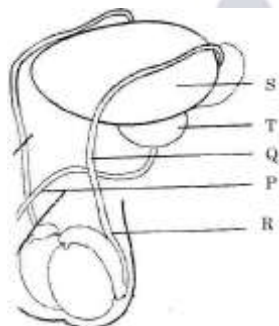
- (a) (II) → (IV) → (III) → (I) → (V)
(b) (I) → (II) → (V) → (IV) → (III)
(c) (III) → (IV) → (I) → (II) → (V)
(d) (IV) → (III) → (II) → (V) → (I)

36. Identify the option that gives the correct type of evolution exhibited by the two animals shown, living in the same habitat in Australia.



- (a) Convergent Evolution
(b) Disruptive Selection
(c) Divergent Evolution
(d) Homologous Ancestry

37. A human male decides to adopt a surgical method for contraception. Identify the point in the diagram where a cut would be made and tied.



- (a) Point S (b) Point R
(c) Point Q (d) Point P

38. Which of the following options correctly matches the name of the hormone to its site of production in the human body?

Name of the Hormone		Site of Production	
(P)	Oxytocin	(I)	Placenta
(Q)	Relaxin	(II)	Corpus Luteum
(R)	hCG	(III)	Pituitary Gland
(S)	Progesterone	(IV)	Ovaries

- (a) (P)-(I), (Q)-(III), (R)-(II), (S)-(IV)
(b) (P)-(I), (Q)-(IV), (R)-(III), (S)-(II)
(c) (P)-(III), (Q)-(IV), (R)-(I), (S)-(II)
(d) (P)-(II), (Q)-(III), (R)-(I), (S)-(IV)

39. Which of the following seeds have remained alive for the longest period ?

- (a) *Phoenix dactylifera* (b) *Striga asiatica*
(c) *Mangifera indica* (d) *Yucca gigantea*

40. Select the options which is/are incorrect statement(s) with respect to T-lymphocytes in the human body.

- (I) They are a type of white blood cells.
(II) They are produced in bone marrow.
(III) They remain active at all times in the body.
(IV) They mature in the bone marrow.

- (a) (I) and (IV) only (b) (III) only
(c) (IV) only (d) (III) and (IV) only

41. Human settlement often leads to habitat loss which leads to fragmentation, forming smaller patches of habitats. Select the statements that describe how a small patch differs from a large patch of the same habitat.

- (I) Invasive species will never be seen here.
(II) Population of large animals decreases.
(III) Biodiversity decreases.
(IV) Competition from surrounding habitats increases.

- (a) (II), (III) and (IV) only (b) (II) and (IV) only
(c) (I) and (III) only (d) (I), (II) and (III) only

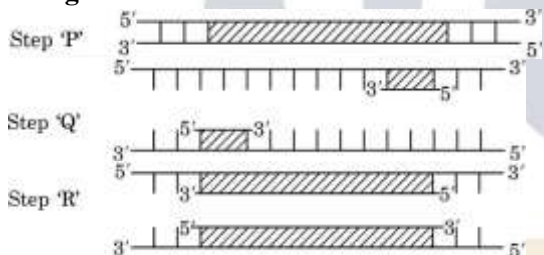
42. Identify the option that does not exhibit a parasitic relationship.

- (a) Head lice in humans
(b) *Cuscuta* on a mango tree
(c) Female *Anopheles*
(d) Ticks on dogs

43. Identify the fungus that ripens the famous 'Roquefort' cheese :

- (a) *Saccharomyces cerevisiae*
(b) *Propionibacterium sharmanii*
(c) *Monascus purpureus*
(d) *Penicillium notatum*

44. The given schematic illustration shows three steps 'P', 'Q' and 'R' of the polymerase chain reaction.

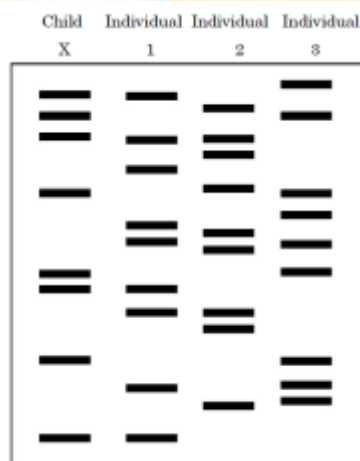


Which of the following statements are correct with reference to the illustration given above?

- (I) Step 'P' is showing denaturation at low temperature.
(II) Step 'Q' is a denaturation of DNA strand at high temperature, followed by annealing.
(III) Step 'R' is an extension of DNA in presence of thermostable DNA polymerase.
(IV) Step 'Q' is extension with two sets of primers.

- (a) (I) and (III) only (b) (II) and (III) only
(c) (II) only (d) (I) only

45. DNA profiles of the child and three individuals 1, 2 and 3 who claim to be the parents of the child are given below. Select the option that shows the correct actual parent/parents of the child.



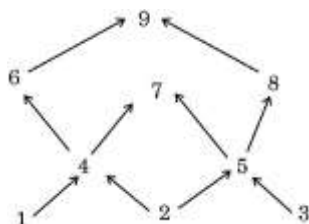
- (a) Individual 1 and 3
 (b) Individual 1 and 2
 (c) Individual 2 and 3
 (d) Individual 1 is the only parent of the child amongst 1,2 and 3

For Questions number 13 to 16, two statements are given-one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as 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.
- 46. Assertion (A) :** In humans the genotype with all the dominant alleles (AABBCC) will have the darkest skin colour.
Reason (R) : In a polygenic trait, phenotype reflects the contribution of each allele.
- 47. Assertion (A) :** The number of white winged moths decreased drastically after industrialisation in England.
Reason (R) : Effects of industrialisation were more marked in rural areas of England.
- 48. Assertion (A) :** More and more children in metro cities of India suffer from allergies and asthma due to sensitivity to the environment.
Reason (R) : Modern day lifestyle and a protected environment in early life has resulted in lowering the immunity.
- 49. Assertion (A) :** The Mediterranean orchid Ophrys uses sexual deceit to get pollinated by a species of bee.
Reason (R) : The female bee changes its colour depending on the temperature of the area.

SECTION B

- 50. (A)** Explain the process of the development of a male gametophyte in an angiosperm.
(B) Why is it called a male gametophyte ?
- 51. (A)** Write the first step the primary effluent undergoes when it enters the secondary treatment plant and state the purpose.
(B) What is the level of B.O.D indicative of in the secondary treatment plant? Mention its significance.
- 52.** Given below is a food web that involves nine organisms.



- (A)** Identify two producers and two carnivores shown in the food web.
(B) Is it possible to make an ecological pyramid depicting this food web? Give reason in support of your answer.
- 53.** Illustrate with the help of an example how introduction of an alien species turns invasive and causes decline of an indigenous species.

54. (A) 'Insertional inactivation' is a method to detect recombinant DNA. Explain the method.

OR

(B) Explain how recombinant DNA technology is used to detect a disease even before any clinical symptom appears.

SECTION C

55. (A) (i) How many types of RNA polymerases are there in a eukaryote cell ? Mention which one of them transcribes hnRNA.

(ii) Write the changes that hnRNA undergoes before it leaves the nucleus as mRNA.

OR

(B) The length of DNA in any cell is far greater than the dimension of its nucleus. Explain how this enormous DNA is packaged in a eukaryotic cell.

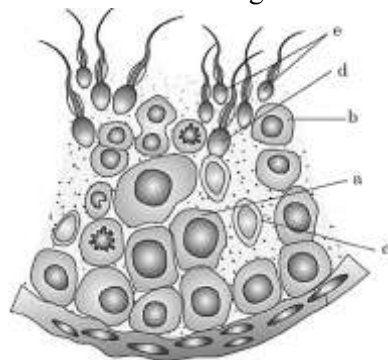
56. Expand and explain the following techniques used in the 'Test Tube Baby' programme :

(A) GIFT

(B) ZIFT

(C) IUI

57. Given below is a diagrammatic sectional view of a seminiferous tubule.



State the developmental process of :

(A) (i) 'b' from 'a'.

(ii) 'e' from 'd'.

(iii) 'd' from 'b'.

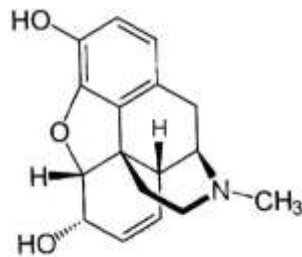
(B) Identify 'a', 'b' and 'c'.

58. (A) Darwin's theory of Natural Selection is widely accepted but some limitations have been identified by modern biologists. Mention the limitations identified.

(B) Name and state the most accepted theory of evolution in modern times.

(C) Mention any two ways the limitations identified in Darwin's theory of evolution are explained in modern biology.

59.



(A) Name the category of drugs represented by the chemical structure given above.

(B) If the methyl group is substituted by acetyl group we get a bitter crystalline compound. Name the compound.

(C) Name the natural source of these compounds.

(D) State the harmful effects of this class of drugs on the human body.

60. (A) Write the scientific name of the nematode that infests the tobacco plants and the part that it infests.

(B) How is Agrobacterium used to protect tobacco plant from this attack?

61. Explain the following population interactions with the help of one example each :

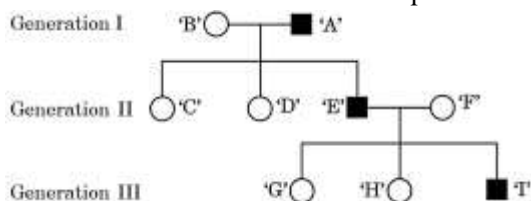
(A) Brood Parasitism

(B) Co-evolution of mutualists

SECTION D

The following questions are case-based questions. Read the cases carefully and answer the questions that follow.

62. The following pedigree chart shows the inheritance of a genetic disorder up to three generations of a family. Observe the chart and answer the questions that follow.

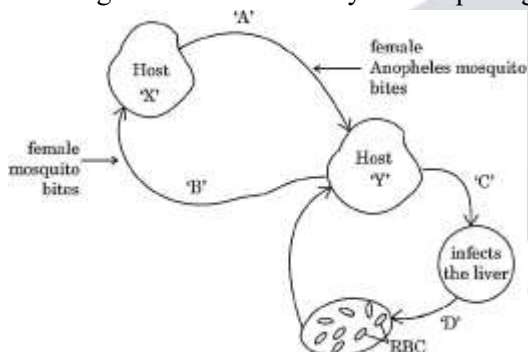


- Is the disease sex-linked or autosomal as per the chart? Give reasons in support of your answer.
- Is it a recessive or a dominant disorder?
- Write the genotypes of the individuals 'C', 'D' and 'H'.
- (A) If the female 'D' marries a normal man, what will be the probability of their daughter being a sufferer of this disease?

OR

- (B) If the mother 'B' is a carrier of the disease, what will be the probability of their daughter being a sufferer of this disease?

63. The diagram shows the life cycle of a pathogenic protozoan.



- Name the parasitic stage that is being transferred from host 'X' to host 'Y'.
- Write the changes the parasite undergoes in the liver.
- Write the changes the parasite undergoes when it enters the RBC.
- (A) Trace the changes the parasite undergoes when the host 'X' takes its blood meal from infected host 'Y'.

OR

- (B) At which stage during the life cycle of the pathogen does the host 'Y' experience the symptoms of the disease? Name the disease and the toxic substance responsible for these symptoms.

SECTION E

64. (A) Answer the following questions with respect to recombinant DNA technology :

- Why is plasmid considered to be an important tool in rDNA technology? From where can plasmids be isolated? (Any two sources)
- Explain the role of 'ori' and selectable marker in a cloning vector.
- "r-DNA technology cannot proceed without restriction endonuclease." Justify.

OR

- (B) Answer the following questions based on Bt-crops :

- Why do farmers prefer to grow Bt cotton crop than genetically unmodified cotton crops?
- Name any two insects that are killed by Bt toxin.
- Explain the mechanism by which Bt toxin kills the insects but not the bacterium which possesses the toxin.

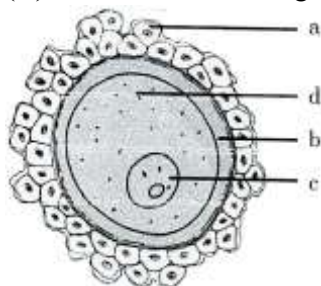
65. (A) Protein synthesis requires the services of all three types of RNAs, namely t-RNA, m-RNA and r-RNA. Explain the role of each of them during the process of protein synthesis in prokaryotes.

OR

- (B) A homozygous tall pea plant with green seeds is crossed with a homozygous dwarf pea plant with yellow seeds.

- Write the possible phenotype and genotype of F_1 generation.
- State the laws of Mendel that are proved true by the F_1 generation.

- (iii) Mention the F_2 phenotypic ratio along with their possible phenotypes.
 (iv) Write the genotypes of the male and female gametes produced by F_1 progeny.
66. (A) Given below is a diagrammatic representation of a human ovum.



- (i) Identify the parts 'a', 'b' and 'c'.
 (ii) This ovum is released from the ovary with incomplete meiotic division. When, where and how is the meiotic division completed?
 (iii) How does an ovum ensure the entry of a single sperm during fertilisation?

OR

- (B) (i) Double fertilisation is an event unique to all flowering plants. Explain the process.
 (ii) Give a reason for the following :
 (1) A seed of an orange has many embryos.
 (2) Cashew is a false fruit but Guava is a true fruit.

General Instructions :

Read the following instructions very carefully and strictly follow them :

- (i) This question paper contains 33 questions. All questions are compulsory.
 (ii) Question paper is divided into FIVE sections - Section A, B, C, D and E.
 (iii) In Section A - question number 1 to 16 are Multiple Choice (MCQ) type questions carrying 1 mark each.
 (iv) In Section B - question number 17 to 21 are Very Short Answer (VSA) type questions carrying 2 marks each.
 (v) In Section C - question number 22 to 28 are Short Answer (SA) type questions carrying 3 marks each.
 (vi) In Section D - question number 29 and 30 are case-based questions carrying 4 marks each. Each question has subparts with internal choice in one subpart.
 (vii) In Section E - question number 31 to 33 are Long Answer (LA) type questions carrying 5 marks each.
 (viii) There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 2 questions in Section D and 1 question in Section E. A candidate has to attempt only one of the alternatives in such questions.
 (ix) Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION - A

67. At which stage during evolution did human use hides to protect their bodies and buried their dead?
 (a) Homo habilis (b) Neanderthal man
 (c) Java man (d) Homo erectus
68. Given below are Column A with a list of certain Assisted Reproductive Technologies (ART) and in Column B the procedures followed during ART :

Column A Names of ART		Column B Procedures	
(A)	GIFT	(I)	Transfer of ovum from a donor into the fallopian tube of another female.
(B)	ICSI	(II)	Transfer of semen from the donor into the vagina of the female.

(C)	ZIFT	(III)	Injecting sperms directly into the ovum.
(D)	IUI	(IV)	Transfer of early embryos into the fallopian tube.

Choose the option where ART correctly matches with the procedure.

- (a) (A)-(I),(B)-(II),(C)-(III),(D)-(IV)
 (b) (A)-(IV),(B)-(I),(C)-(II),(D)-(III)
 (c) (A)-(IV),(B)-(III),(C)-(I),(D)-(II)
 (d) (A)-(I),(B)-(III),(C)-(IV),(D)-(II)

69. The decrease in the T-lymphocytes count in human blood will result in :

- (a) Decrease in antigens
 (b) Decrease in antibodies
 (c) Increase in antibodies
 (d) Increase in antigens

70. Given below is a sequence of bases in mRNA of a bacterial cell. Identify the amino acid that would be incorporated at codon position 3 and codon position 5 during the process of its translation.

3' AUCAGGUUUGUGAUGGUACGA 5'

- (a) Phenylalanine, Methionine
 (b) Cysteine, Glycine
 (c) Alanine, Proline
 (d) Serine, Valine

71. A Tight one-to-one relationship between many species of fig tree and certain wasps is an example of -

- (a) Commensalism (b) Parasitism
 (c) Amensalism (d) Mutualism

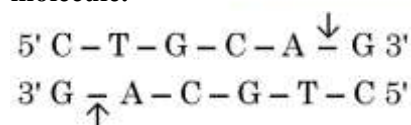
72. Select the pathogen mismatched with the symptoms of disease caused by it from the list given below :

- (a) Entamoeba histolytica: Constipation, abdominal pain.
 (b) Epidermophyton : Dry scaly lesions on nail.
 (c) Wuchereria bancrofti : Chronic inflammation of lymphatic vessels of lower limb.
 (d) Haemophilus influenzae: Blockage of the intestinal passage.

73. The primary productivity in an ecosystem is expressed as :

- (a) $\text{gm}^{-2}\text{yr}^{-1}$ (b) gm^{-2}yr
 (c) $\text{K cal m}^{-2}\text{yr}^{-1}$ (d) K cal m^{-2}

74. Given below is the restriction site of a restriction endonuclease Pst-I and the cleavage sites on a DNA molecule.



Choose the option that gives the correct resultant fragments by the action of the enzyme Pst-I.

- (a) $5' \text{ C - T - G } \quad \text{C - A - G } 3'$
 $3' \text{ G - A - C - G - T } \quad \text{C } 5'$
 $5' \text{ C - T } \quad \text{G - C - A - G } 3'$
 (b) $3' \text{ G - A - G - C } \quad \text{T - C } 5'$
 $5' \text{ C - T - G - C } \quad \text{A - G } 3'$
 (c) $3' \text{ G - A - C - G } \quad \text{T - C } 5'$
 $5' \text{ C - T - G - C - A } \quad \text{G } 3'$
 (d) $3' \text{ G } \quad \text{A - C - G - T - C } 5'$

75. The IUCN Red Data List (2004) in the last 500 years documents the extinction of nearly 784 species including :

- (a) 330 invertebrates (b) 338 invertebrates
(c) 359 invertebrates (d) 362 invertebrates

76. Given below are the list of the commercially important products and their source organisms. Select the option that gives the correct matches.

List A Bioactive Products		List B Microbes (Source Organism)	
(A)	Cyclosporin A	(I)	<u>Streptococcus</u>
(B)	Statins	(II)	<u>Tricoderma polysporum</u>
(C)	Streptokinase	(III)	<u>Penicillium not</u>
(D)	Penicillin	(IV)	Monascus purpureus

- (a) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(b) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
(c) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(d) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

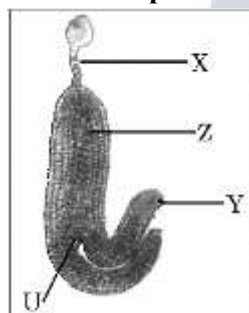
77. Important attributes belonging to a population but not to an individual are :

- (I) Birth rate and death rate
(II) Male and female
(III) Birth and death
(IV) Sex-ratio

Select the correct option from the given options :

- (a) (I) only (b) (II) only
(c) (II) and (III) (d) (I) and (IV)

78. Select the option that shows the correctly identified 'U', 'X', 'Y' and 'Z' in a developing dicot embryo.



- (a) X - Plumule (2n), Y - Suspensor (n), Z - Cotyledon (2n), U - Radicle (2n).
(b) X - Plumule (2n), Y - Suspensor (2n), Z - Radicle (2n), U - Cotyledon (2n).
(c) X - Suspensor (2n), Y - Cotyledon (2n), Z - Radicle (2n), U - Plumule (2n).
(d) X - Cotyledon (2n), Y - Radicle (n), Z - Plumule (n), U - Suspensor (n).

Question Nos. 13 to 16 consists of two statements, Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below :

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true, but (R) is not the correct explanation of (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true.

79. **Assertion (A) :** Determining the sex of an unborn child followed by MTP is an illegal practice.

Reason (R) : Amniocentesis is a practice to test the presence of genetic disorders also.

80. **Assertion (A) :** Synthetic oligonucleotide polymers are used during Annealing in a PCR.

Reason (R) : The primers bind to the double stranded DNA at their complementary regions.

81. **Assertion (A) :** Decomposition process is slower if detritus is rich in lignin and cutin.

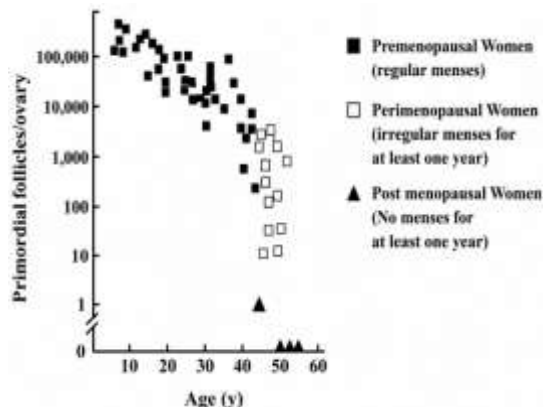
Reason (R) : Decomposition is largely an oxygen requiring process.

82. Assertion (A) : In Thalassaemia an abnormal myoglobin chain is synthesized due to a gene defect.

Reason (R) : α -Thalassaemia is controlled by genes HBA1 and HBA2 on chromosome 16.

SECTION – B

83. The graph given below shows the number of primordial follicles per ovary in women at different ages. Study the graph and answer the questions that follow.



(A) What is the average age of the women at the onset of menopause ?

(B) At what age are maximum primordial follicles present in the ovary, according to the given graph ?

84. "Cattle and goats do not browse the Calotropis plant." Justify the statement giving reasons.

85. By using Punnett square depict the genotypes and phenotypes of test crosses (where green pod colour (G) is dominant over yellow pod colour (g)) in Garden pea with unknown genotype.

86. (A) (i) Give an example of a genus of virus used as narrow spectrum insecticidal biocontrol agent.

(ii) How does its use serve as an aid in overall integrated pest management programme?

OR

(B) Why a malignant tumour considered to be more damaging than a benign tumour? Explain.

87. (A) Write the scientific name of the source organism of the thermostable DNA polymerase used in PCR.

(B) State the advantage of using Thermostable DNA polymerase.

SECTION-C

88. Name and explain a surgical contraceptive method that can be adopted by the male partner of a couple.

89. Human Genome Project (HGP) was a mega project launched in the year 1990 with some important goals.

(A) Enlist any four prime goals of HGP.

(B) Name any one common non-human animal model organism which has also been sequenced thereafter.

90. Industrial melanism in England after 1850 is an excellent example of Natural selection. Explain how?

91. One of the major approaches of crop improvement programme is Artificial Hybridisation. Explain the steps involved in making sure that only the desired pollen grain pollinate the stigma of a bisexual flower by a plant breeder.

92. (A) "Plasmodium protozoan needs both a mosquito and a human host for its continuity." Explain.

OR

(B) We all must work towards maintaining good health because 'health is wealth'. Enlist any six ways of achieving good health.

93. On spraying *Bacillus thuringiensis* on an infected cotton crop field the pests are killed by the toxin, however the toxin although produced by the bacteria does not affect it. Explain giving reason.

94. "Biodiversity plays a major role in many ecosystem services that nature provides."

(A) Describe any two broadly utilitarian arguments to justify the given statement.

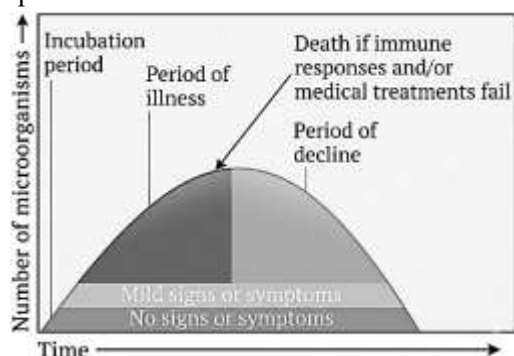
(B) State one ethical reason of conserving biodiversity.

SECTION – D

Q. Nos. 29 and 30 are case based questions. Each question has subparts with internal choice in one subpart.

95. When a microorganism invades a host, a definite sequence of events usually occur leading to infection and disease, causing suffering to the host. This process is called pathogenesis. Once a microorganism overcomes the defense system of the host, development of the disease follows a certain sequence of events as shown in the graph.

Study the graph given below for the sequence of events leading to appearance of a disease and answer the questions that follow :



(A) In which period, according to the graph there are maximum chances of a person transmitting a disease / infection and why?

(B) Study the graph and write what is an incubation period. Name a sexually transmitted disease that can be easily transmitted during this period. Name the specific type of lymphocytes that are attacked by the pathogen of this disease.

OR

(B) Draw a schematic labelled diagram of an antibody.

(C) In which period, the number of immune cells forming antibodies will be the highest in a person suffering from pneumonia?

Name the immune cells that produce antibodies.

96. The chromosome number is fixed for all normal organisms leading to species specification whereas any abnormality in the chromosome number of an organism results into abnormal individuals. For example, in humans 46 is the fixed number of chromosomes both in male and female. In male it is '44 + XY' and in female it is '44 + XX'. Thus the human male is heterogametic, in other words produces two different types of gametes one with '22 + X' chromosomes and the other with '22 + Y' chromosomes respectively. Human female, on the other hand is homogametic i.e. produces only one type of gamete with '22 + X' chromosomes only.

Sometimes an error may occur during meiosis of cell cycle, where the sister chromatids fail to segregate called nondisjunction, leading to the production of abnormal gametes with altered chromosome number. On fertilisation such gametes develop into abnormal individuals.

(A) State what is aneuploidy.

(B) If during spermatogenesis, the chromatids of sex chromosomes fail to segregate during meiosis, write only the different types of gametes with altered chromosome number that could possibly be produced.

(C) A normal human sperm (22 + Y) fertilises an ovum with karyotype '22 + XX'. Name the disorder the offspring thus produced would suffer from and write any two symptoms of the disorder.

OR

(C) Name a best known and most common autosomal aneuploid abnormality in human and write any two symptoms.

SECTION-E

97. (A) (i) Explain the monosporic development of embryo sac in the ovule of an angiosperm.
(ii) Draw a diagram of the mature embryo sac of an angiospermic ovule and label any four parts in it.

OR

(B) (i) Explain the formation of placenta after the implantation in a human female.

(ii) Draw a diagram showing human foetus within the uterus and label any four parts in it.

98. (A) Name and describe the steps involved in the technique widely used in forensics that serves as the basis of paternity testing in case of disputes.

OR

(B) It is sometimes observed that the F_1 progeny has a phenotype that does not resemble either of the two parents and has intermediate phenotype. Explain by taking a suitable example and working out the cross upto F_2 progeny.

99. (A) Bioreactors are the containment vehicles of any biotechnology-based production process. For large scale production and for economic reasons the final success of biotechnological process depends on the efficiency of the bioreactor.

Answer the following questions w.r.t. the given paragraph :

- (i) List the operational guidelines that must be adhered to so as to achieve optimisation of the bioreactor system. Enlist any four.
- (ii) Mention the phase of the growth we refer to in the statement "Optimisation of growth and metabolic activity of the cells".
- (iii) Is the biological product formed in the bioreactor suitable for the intended use immediate? Give reason in support of your answer.

OR

- (B) (i) 'EcoRI' has played very significant role in r-DNA technology.
- (I) Explain the convention for naming EcoRI.
- (II) Write the recognition site and the cleavage sites of this restriction endonuclease.
- (ii) What are the protruding and hanging stretches of DNA produced by these restriction enzymes called ? Describe their role in formation of r-DNA.

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- (vi) In Section D - question number 29 and 30 are case-based questions carrying 4 marks each. Each question has subparts with internal choice in one subpart.
- (vii) In Section E - question number 31 to 33 are Long Answer (LA) type questions carrying 5 marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 2 questions in Section D and 1 question in Section E. A candidate has to attempt only one of the alternatives in such questions.
- (ix) Wherever necessary, neat and properly labelled diagrams should be drawn.

SECTION - A

100. Which one of the following option depicts the mode of action of a hormone-releasing intrauterine device?

- (a) That makes the uterus suitable for implantation.
- (b) That makes the cervix hostile to sperms.
- (c) That decreases phagocytosis of sperms within the uterus.
- (d) That increases sperm motility.

101. Column I lists the objectives of Reproductive and Child Health Care (RCH) programme and Column II lists the purpose of these objectives.

Column I (Objectives of RCH Programme)		Column II (Purpose)	
(P)	Introduction of sex-education in schools	(I)	To encourage the infected persons to consult experts for timely detection and proper treatment
(Q)	Advocating programmes for married couples	(II)	To avoid social evils like sex-abuse and sex-related crimes
(R)	Awareness of problems	(III)	To discourage children from

	due to uncontrolled population growth		believing in myths and misconceptions in sex-related matters
(S)	Knowledge and diagnosis of STD infections	(IV)	Be aware of available birth control options

Which one of the following options correctly matches the objective in Column I with the purpose in Column II ?

- (a) (P)-(I), (Q)-(II), (R)-(III), (S)-(IV)
 (b) (P)-(III), (Q)-(IV), (R)-(II), (S)-(I)
 (c) (P)-(II), (Q)-(I), (R)-(IV), (S)-(III)
 (d) (P)-(IV), (Q)-(III), (R)-(I), (S)-(II)

102. The backbone (basic chemical structure) of a DNA molecule is composed of :

- (a) Sugar – Phosphate (b) Phosphate - Purine
 (c) Sugar – Pyrimidine (d) Purine-Pyrimidine

103. The correct reason for survival of certain moth population in post-industrialisation period in England was due to :

- (a) the moths moved to a different type of vegetation and survived.
 (b) the moths flew away to a different locality.
 (c) the moths that were able to camouflage their colour with the background, survived.
 (d) the reproductive rate of moths declined post-industrialisation.

104. Column I lists some infectious diseases and Column II lists the mode of their spreading. Identify the correct pair.

Column I (Disease)		Column II (Mode of Spreading)	
(a)	Typhoid	(I)	Vector-borne
(b)	Malaria	(II)	Contaminated food and water
(c)	Chikungunya	(III)	Airborne
(d)	Pneumonia	(IV)	Be aware of available birth control options

105. Which one of the following option is not a characteristic of acquired immunity?

- (a) It is pathogen specific.
 (b) It is not characterised by memory.
 (c) On first contact it produces a primary response.
 (d) Subsequent encounter elicits a secondary response.

106. Which one of the following options is a correct example of fungus as a source organism ?

- (a) Streptokinase - 'clot buster'
 (b) Yeast - commercial preparation of ethanol
 (c) Butyric acid - organic acid
 (d) Acetic acid - food item

107. The correct method of introducing alien DNA into the appropriate host is :

- (a) Microinjection - animal cell

- (b) Incubating cells followed - nucleus of an animal by temperature shocks cell/plant cell
- (c) Biolistics - bacteria
- (d) 'Disarmed pathogen' vectors - plants

108. In which one of the following population interactions are both the partners benefitted?

- (a) Predation
- (b) Commensalism
- (c) Ammensalism
- (d) Mutualism

109. Why are some species of insects and frogs cryptically coloured ?

- (a) To attract the opposite sex
- (b) To procure food
- (c) To survive adverse conditions
- (d) To avoid detection by predators

110. In an ideal pyramid of energy, the energy available to primary producers is 10,000 J, whereas the energy available to the tertiary consumer in this pyramid of energy will be :

- (a) 1.0 J
- (b) 100 J
- (c) 1000 J
- (d) 10 J

111. The largest species-rich taxonomic group of plants among the following is :

- (a) Fungi
- (b) Angiosperms
- (c) Algae
- (d) Gymnosperms

For Questions number 13 to 16, two statements are given-one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as 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.

112. **Assertion (A) :** Endosperm development precedes embryo development.

Reason (R) : Endosperm development occurs only in dicotyledonous plants.

113. **Assertion (A) :** ABO blood groups in humans exhibit the phenomenon of co-dominance.

Reason (R) : The first filial generation expresses both parental and new characters.

114. **Assertion (A) :** Transgenic animals possess an extra (foreign) gene in their DNA.

Reason (R) : Transgenic animals can pass on the manipulated genes to their offsprings.

115. **Assertion (A) :** Species diversity decreases as we move away from the equator towards the poles.

Reason (R) : Tropics have more species than temperate regions.

SECTION B

116. (A) What is a 'cervical canal'?

(B) When is it referred to as 'birth canal' ?

117. (A) Name the scientists who combined the knowledge of chromosomal segregation with Mendelian principles.

(B) How did they explain the similarity in behaviour of chromosomes and genes?

118. (A) Which of the pollinating agents is used in small proportion by flowering plants?

(B) Name the group of flowering plants which use this agent.

(C) Write two examples of aquatic plants where water is not the pollinating agent.

119. What trait is coded by the piece of DNA which is introduced in E. coli, a host bacterium, as compared to normal cells in transformation as selectable markers?

120. (A) The density of a population in a given habitat during a given period, fluctuates due to changes in four basic processes.

(i) Which two of them contribute to an increase in population density?

(ii) Which two of them contribute to a decrease in population density?

OR

- (B) (i) Distinguish between 'J' and 'S'-shaped population growth curves.
(ii) Which curve is more realistic? Why?

SECTION C

121. Explain the role of different hormones that lead to ovulation in a normal human female. Name the structure that is formed after ovulation in the ovary and state its function.
122. Explain the process of triple fusion and double fertilisation in angiosperms.
123. Name the main enzyme involved in replication of DNA in E. coli. List the two characteristics of this enzyme. What would happen if the enzyme makes "mistakes" during replication?
124. 'Analogous structures are a result of convergent evolution.' Explain with the help of an example from plants.
125. (A) List three features that are common between infections like AIDS and Hepatitis-B.

OR

- (B) (i) Mention the characteristic changes that you observe in adolescence ? Why is it considered to be a vulnerable phase?
(ii) What does drug dependence lead to and why does it happen ?
126. Explain the process of isolation of DNA from a plant cell, for recombinant DNA technology.
127. Give one example for each of the following population interactions:
(A) Morphological defence in plants against herbivores
(B) Chemical defence in animals against predators
(C) Brood parasitism

SECTION D

128. The unequivocal proof that DNA is a genetic material came from the experiments of Alfred Hershey and Martha Chase in 1952. They worked with viruses that infect bacteria and are called bacteriophages. The experiments were designed to ascertain whether it was protein or DNA from the viruses that entered the bacteria. Radioactive elements were used to label DNA and proteins in the bacteriophages. Recall the experiment and answer the questions that follow :
(i) (A) Why were viruses grown in medium containing radioactive phosphorus?
(B) What happened when viruses were grown in medium containing radioactive sulfur ?
(ii) Why were bacteriophage and E.coli used in the experiment ?
(iii) (A) Write the conclusion that Hershey and Chase arrived at, at the end of this experiment.

OR

- (B) Why was a blender used during this experiment ?
129. Some helminths are known to be pathogenic to humans. A healthy person acquires this helminth infection through contaminated water, vegetables, fruits, etc. The common roundworm, filarial worms live as parasites in humans. Besides helminths some fungi also cause common infectious diseases in humans. Maintenance of personal and public hygiene is very important for prevention and control of many such infectious diseases. Public hygiene includes proper disposal of waste and excreta, periodic cleaning and disinfection of water reservoirs.
(i) Name the causal organisms for filariasis and ringworm.
(ii) Mention two symptoms each of filariasis and ringworm.
(iii) (A) How do these diseases spread ?

OR

- (B) Write two preventive measures each for filariasis and ringworm.

SECTION E

130. (A) State the main purpose of conducting 'Artificial Hybridisation' in plants ? Explain the process in detail. What type of plants do not require this process?

OR

- (B) (i) Explain the structure and function of the three major parts of a human sperm.
(ii) Mention the sperm count in each ejaculation of a normal human male during coitus ?
131. (A) List five reasons to explain why Morgan chose to work with fruit flies, *Drosophila melanogaster*.

OR

- (B) (i) List any two objectives of the Human Genome Project.
(ii) Describe the two types of methodologies used for this project.

(iii) Name the two hosts commonly used for cloning during sequencing of genes.

(iv) Write the contribution of Frederick Sanger in Human Genome Project.

132. (A) (i) What is the cause of ADA deficiency in children ?

(ii) Explain how gene therapy is used to cure this deficiency.

(iii) Why does a patient require periodic infusion of genetically engineered lymphocytes?

OR

(B) (i) How has the process of RNA interference helped in saving the tobacco plants from infestation by a nematode?

(ii) Name the part of the tobacco plant that is infected by the nematode and mention the harm it causes.

