SECTION A

1. **(c)**
2. **(d)**
3. **(b)**
4. **(a)**
5. **(d)**
6. **(a)**
7. **(a)**
8. **(c)**
9. **(b)**
10. **(b)**
11. **(b)**
12. **(a)**
13. **(c)**
14. **(a)**
15. **(b)**
16. **(c)**

SECTION B

17. **(A)** Heroin is obtained by acetylation of morphine / Both are opioids.
Effects - Morphine is a very effective sedative/painkiller
- Heroin is a depressant/slows down body functions.

OR

(B) (i)
(1) Whisky/ Brandy/ Rum
(2) Wine/Beer
(ii) Cyanobacteria fix atmospheric nitrogen, add organic matter to soil ,and increase soil fertility.

18. **(A)** Natural old forest will be more productive, As it contains more biomass or high biodiversity which will trap and store solar radiation in form of biomass, Young forest is still developing and contain fewer tress will not capture solar radiations as much as old forest so productivity is low, Shallow polluted lake contains less number of producers and high amount of dead organic matter so productivity is less in comparison to natural old forest.

OR

(B)

Net Primary Productivity	**Gross Primary Productivity**
(i) Gross primary productivity minus respiration losses (R) is the net primary productivity. (ii) It is the available biomass for the consumption to heterotrophs.	(i) Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. (ii) A considerable amount of gross primary utilised by plants respiration. (Any one point)

19. 1 = Klinefelter's Syndrome (44 + XXY)
2 = Turner's Syndrome (44 + XO)

Klinefelter's Syndrome	Turner's Syndrome

Presence of an extra copy of X chromosome / total 47chromosomes/Trisomy of sex chromosomes	Absence of one of the X chromosome/ total 45 chromosomes/ monosomy of sex chromosomes
Sterile male	Sterile female
Overall-masculine development with feminine features/Gynaecomastia or develpoment of breast/ tall statured/	Rudimentary ovaries / lack of secondary sexual characters/short strature/underdeveloped feminine character (any other relevant symptom)

20. **(a)** Individual $1 = I_i^{Bi}$

Individual $2 = I^A$ i

(b) Individual 5 - Antigens A and B both are present on RBCs Individual 8 - Neither antigen A nor Antigen B is present on the RBCs

21. **(A)** The genetically engineered lymphocytes are not immortal hence the patient requires periodic infusion

There could be permanent cure if the gene isolated from bone marrow cells producing ADA is introduced into cells (lymphocytes) at early embryonic stages

OR

(B) Micro-injection, Recombinant DNA is directly injected into the nucleus of an animal/

Biolistics or gene gun, plants cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA/

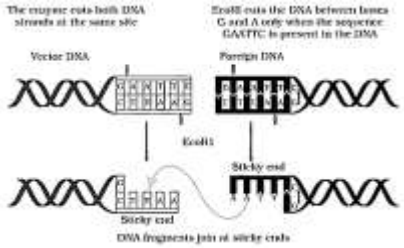
Heat shock, Recombinant DNA can then be forced into such cells by incubating the cells with recombinant DNA on ice which is followed by placing them briefly at $42°C$ (heat shock) and then putting them back on ice.

SECTION C

22. (a) $3' - CTTAAG - 5'$

(b) EcoR-I

(c) -Restriction enzyme cuts the strand of DNA between the same two bases on the opposite strands. This leaves single stranded portion or overhanging stretches at the two ends known as sticky ends.



-Role of sticky ends:

Sticky ends forms hydrogen bond with their complementary cut counter part/ they help in joining of vector DNA and foreign DNA during rDNA technology /stickiness of ends facilitates the action of enzyme DNA ligase

23. **(a)** Sporozoites

(b) In the gut of the female Anopheles mosquito

(c) P: Salivary gland of female Anopheles mosquito

Q: Gametocytes

(d) Asexual phase = In human

Sexual phase = In mosquito

24. **(a)** Alien species invasion - Nile perch introduced in Lake Victoria in East Africa led to extinction of 200 species of cichlid fish / Threat posed to our native species by invasive weed species like carrot grass (Parthenium) or Lantana or water hyacinth (Eicchornia) / Illegal introduction of the African catfish Clarias gariepinus for aquaculture is posing a threat to the indigenous catfish/ any other relevant example

Habitat loss and fragmentation -When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territory habits are badly affected leading to population decline / Amazon rain forest harbouring probably millions of species is being cut and cleared for cultivation of soya bean or conversion of grassland for raising of cattle / any other relevant example

(b) (i) IUCN Red data list - Provides information about species under the threat of extinction /is to identify and protect species facing a high risk of extiction / crucial for conservation planning

(ii) Hot spots - have very high levels of species richness and high degree of endemism

25. (a) Nucleosome

(b) P = DNA Q = Histone octamer

(c) Basic/ Positively charged

(d)

Euchromatin		**Heterochromatin**	
1.	Loosely packed chromatin	1.	Densely packed chromatin
2.	Lightly stained	2.	Darkly stained
3.	active chromatin	3.	Transcriptionally inactive chromatin

26. (a) Amniocentesis,

In amniocentesis some of the amniotic fluid of the developing embryo is taken to analyse the foetal cells and dissolved substances to test the presence of genetic disorders.

(b) -Medical Termination of Pregnancy/MTP

-Yes

-as MTP is comparatively safe upto 12 weeks or the first trimester of pregnancy.

(c) When it is performed by quacks / if foetus is a normal female followed by MTP leading to female foeticide

27. Negatively charged DNA molecules move towards the anode under electric field through a medium or matrix, DNA fragments separate according to their size through sieving effect/Small sized DNA fragments move faster.

Resultant DNA fragments can be utilized:

For Recombinant DNA technology,

In DNA fingerprinting, In Polymerase Chain Reaction

28. Differences

Divergent evolution	Convergent evolution
Divergent evolution occurs when same structures developed along different directions due to adaptations to different needs	Convergent evolution occurs when different structures evolving for the same function and hence having similarities
Divergent evolution produces homologous structures.	Convergent evolution can result in analogous structures
It indicates common ancestory	It indicates similar habitat has resulted in selection of similar adaptive features

Similarities:

-both are influenced by the environment /

-both contribute to species evolution or any other valid point.

SECTION D

29. **(a)** Luteinising hormone / LH, helps in ovulation / induce rupturing of graafian follicles

(b) Ovary: Maturation of follicles.

Uterus: Proliferation of endometrium lining.

(c) Q - Progesterone,

Maintains pregnancy / maintenance of endometrium

OR

(d) Corpus luteum, Graafian follicle transforms into corpus luteum after ovulation

30. **(a)** The butterfly acquires this chemical during its caterpillar stage by feeding on a poisonous weed.

(b) $\mathrm{Nt} + 1 = \mathrm{Nt} + [(\mathrm{B} + \mathrm{I}) - (\mathrm{D} + \mathrm{E})]$

$800 = \mathrm{Nt} + [(200 + 200) - (150 + 100)]$

$800 = \mathrm{Nt} + (400 - 250)$

$800 = \mathrm{Nt} + 150$

$\mathrm{Nt} = 800 - 150 = 650$

Comment

-As the population density is increasing with time so age pyramid would be of expanding population.

(c) Single huge banyan tree - measured in terms of biomass or percent cover ,

carrot grass- measured in terms of percent cover

OR

(d) Pug marks, faecal pellets.

SECTION E

31. **(A) (i)**

- MALT is Mucosa Associated Lymphoid Tissue
- It is located within the lining of the major tracts like Respiratory or digestive or urogenital tract.

(ii) Cytokine barriers - virus infected cells secrete proteins called interferons which protect non-infected cells from further viral infection.

(iii) Enzyme Linked Immuno-sorbent Assay or ELISA ,ELISA is based on the principle of antigen-antibody interaction

/

PCR or Polymerase Chain Reaction, amplification of nucleic acid

(iv) Both Bone marrow and thymus provide micro- environment for the development and maturation of T-lymphocytes / immature lymphocyte differentiate into antigen sensitive lymphocytes / Bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced and some lymphocytes migrate to thymus for development and maturation.

OR

(B) (i) (a) H = Clostridium butylicum

I=Bacteria

(b) J = Statin

K = Fungi / Yeast

(c) L = Trichoderma polysporum

M = Immunosuppressant/Suppress immune system in patients with newly transplanted organs

(ii) Baculovirus are species specific, narrow spectrum insecticidal properties, No negative impact on non target species like plants or mammals or birds or fishes or Any other valid point.

32. **(A) (a)**

Vegetative cell	Generative cell
It is big with abundant food reserve and an irregular shaped nucleus	Generative cell is small, floats in the cytoplasm of the vegetative cell

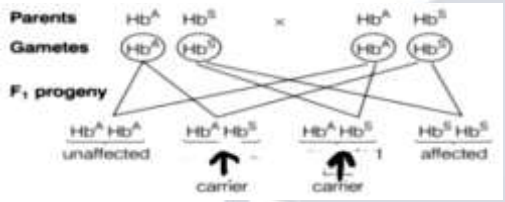
Helps in the formation of pollen tube	Forms two male gamete

(b) (i) 1 = Autogamy
2 = Geitonogamy
3 = Xenogamy
(ii) a = by Insects or wind
b = by Water
(iii) Genetic variation, Healthier offspring,Elimination of recessive traits, Disease resistance ,Evolution, no inbreeding depression, promotes heterosis

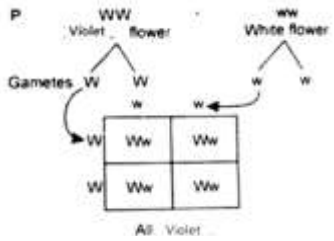
OR

(B) (i) *P* is able to penetrate or fertilise the ovum, whereas *Q* and *R* are unable to penetrate or fertilise.
(ii) When a sperm comes in contact with the zona pellucida layer of the ovum it induces changes in the membrane that blocks the entry of additional sperms.
(iii) Entry of sperm induces completion of meiotic division of the secondary oocyte and formation of second polar body and a haploid ovum (ootid)
(iv) -Acrosome : It is filled with the enzyme which helps the sperm to enter into the cytoplasm of the ovum
-Middle piece : It has numerous mitochondria which produce energy for the movement of tail that facilitate sperm motility for fertilisation

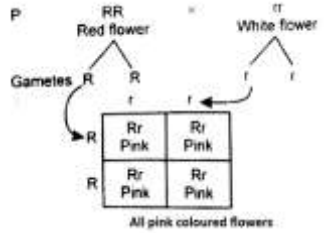
33. (A) (i)



-Ratio 2: 1: 1
(Carrier: Disease free: Diseased)
($\frac{1}{2}$ mark for the correct cross and $\frac{1}{2}$ mark for the correct ratio)
- Adenine is substituted by Thymine
(ii) Inheritance pattern of flower colour in garden pea plant follows Law of Dominance because violet colour is dominant over white colour of flower.



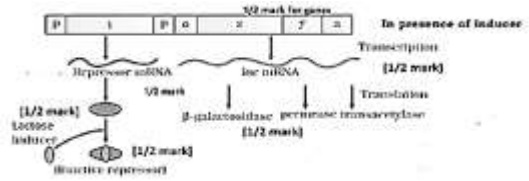
In case of snapdragon the flower colour shows incomplete dominance and all the F1 progeny is of pink colour because red colour is not completely dominant over recessive white colour.



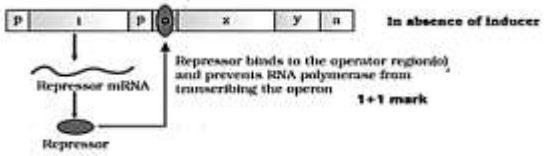
($\frac{1}{2}$ mark for the correct explanation and 1 mark for the correct cross)

OR

(B) (i) In presence of inducer



(ii) In absence of inducer



SECTION-A

34. **(b)**
35. **(b)**
36. **(c)**
37. **(c)**
38. **(b)**
39. **(b)**
40. **(d)**
41. **(d)**
42. **(a)**
43. **(b)**
44. **(d)**
45. **(b)**
46. **(a)**
47. **(c)**
48. **(a)**
49. **(c)**

SECTION B

50. **(A) (i)** The moisture content becomes reduced and the seeds became relatively dry ,the metabolic activity of the embryo slows down (dormancy).

(ii) Lupinus arcticus / Lupine

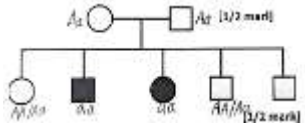
OR

(B) (i) Pea flowers are cleistogamous/ shows autogamy/ carry out self pollination.

(ii) P- haploid/n, Q- diploid/2n

51. **(a)** Autosomal recessive trait

Normal carrier parents / Heterozygous individuals, transfer defective gene to both male and female progeny producing affected individuals or homozygous recessive individuals



(b) Sickle cell anaemia / Cystic fibrosis / Phenylketonuria / Thalassemia / or any other example (anyone)

52. **(A)** -In case of snakebite, quick response is required as natural production of antibodies will take more time therefore preformed antibodies against the snake venom are injected.

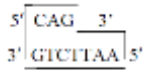
-In tetanus, preformed antibodies are directly injected because quick immune response is required against deadly microbes.

OR

(B) The symptoms do not appear immediately as parasite initially multiply within the liver cells, and then attack RBCs, resulting in their rupture and, release toxic substance haemozoin.

53. (a) EcoRI

(b)



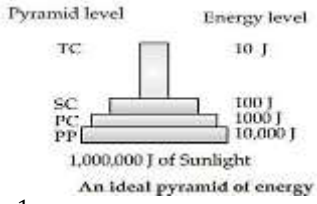
(c) Ends are called as sticky ends because they form hydrogen bonds with their complementary cut counterparts.

54. (A) Expanding age pyramid.

The number of individuals in the pre-productive age group is more than that in the reproductive age group, Number of Post reproductive individuals are less than reproductive individuals.

OR

(B) (i)



[$\frac{1}{2}$ mark for correct pyramid, $\frac{1}{2}$ mark for correct trophic level, $\frac{1}{2}$ mark for correct representation of energy levels]

(ii) 10 J

SECTION – C

55. (a) 3200 male gametophyte

(b) -Intine made up of cellulose, and pectin.

-Exine made up of sporopollenin.

56. (a) Copper releasing IUDs release copper ions that supress sperm motility, Supress the fertilising capacity of sperms, increase phagocytosis of sperms

(b) The oral pills inhibit ovulation and implantation / It alter the quality of cervical mucus to prevent or retard the entry of sperms.

57. Cross – 1 GG × Gg

Homozygous Dominant female — Heterozygous male

Gamete G G — G g

F_1

	G	g
G	GG	Gg
G	GG	Gg

All dominant progenies are produced

Cross – 2 gg × Gg

Homozygous recessive female — Heterozygous male

g g — G g

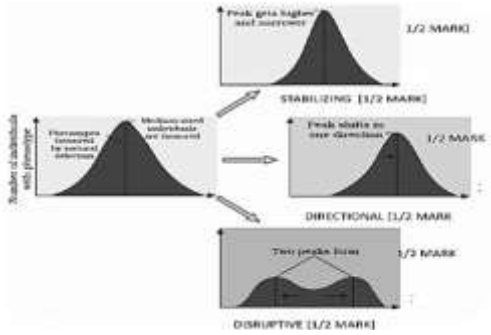
F_1

	G	g
G	Gg	gg

g	Gg	gg

50% dominant & 50% recessive Progenues are produced

58.



(Correct diagram with labelling or correct explanation with diagram to be considered)

59. **(a)** Sportspersons abuse certain drugs to increase their muscle strength and bulk and aggressiveness for better performance in sports.

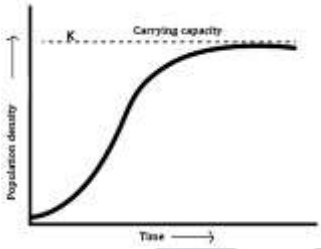
(b) Cocaine/coca alkaloids, cannabinoids, any other correct example (any two)

(c) Erythroxylum , Cannabis , any other correct example

60. **(a)** Insulin synthesized in our body as prohormone (proinsulin) which contain extra stretch of C-peptide apart from A and B peptide, Eli Lilly company synthesized insulin in functional form with only two peptide A and B .

(b) Insulin from animal sources caused some allergy or other type of immune reactions to the foreign protein / Insulin can be easily obtained in large quantity from bacteria

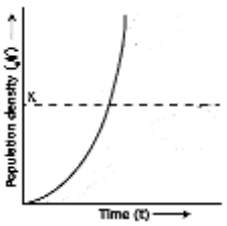
61. **(a)**



(b) - Verhulst-Pearl logistic growth/ Logistic growth curve/ Sigmoid growth curve

- Since resource for growth for most animal populations are finite and become limiting sooner or later.

(c)



Equation: $\frac{dN}{dt} = rN/\frac{dN}{dt} = (b-d)N/N_t = N_0e^{rt}$

SECTION-D

62. **(a)** B-lymphocytes, and T-lymphocytes.

(b) Because the antibodies are found in the blood hence antibody-mediated immunity is also called humoral immune response.

(c) **(i)** Our immune system is able to distinguish between 'self' and 'non-self' cells/molecules.

(ii) Cell-mediated immune response, T-lymphocytes are involved.

OR

(d)

Active immunity	Passive immunity

When antibodies are produced by B-cells within the body.	Preformed antibodies are injected into the body for defence
It is produces comparatively slow response	It provides quick response

63. **(a)** DNA -dependent RNA polymerase

(b) B-coding strand, A-Template strand

(c) - C is promoter, it is the sequence of DNA where the enzyme DNA dependent RNA polymerase binds for initiation of transcription.

- D is the terminator, it is the sequence of DNA where the process of transcription terminated.

OR

(d) - C is located towards 5′ end (upstream) of coding strand

- D is located towards 3′ end (downstream) of coding strand

SECTION E

64. **(A) (i)**

Megaspore mother cell —(Meiosis)→ Tetrad

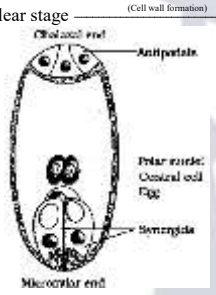
(2n) ↓ (n)

3 Mitosis without cell wall formation / Free Nuclear division ← Degeneration of 3 Cells (one functional megaspore left)

↓ (n)

8 nuclear stage —(Cell wall formation)→ Embryo sac (7 celled 8 nucleated stage)

(ii)



OR

(B) (i) Menstrual phase → proliferative / follicular phase → ovulatory phase → luteal / secretory phase.

(ii) 3-5 days.

(iii) - Estrogen reaches its peak during proliferative phase just before ovulation, because it is secreted by the growing follicles.

- Progesterone reaches its peak during luteal phase or secretory phase, it is because progesterone is secreted by corpus luteum.

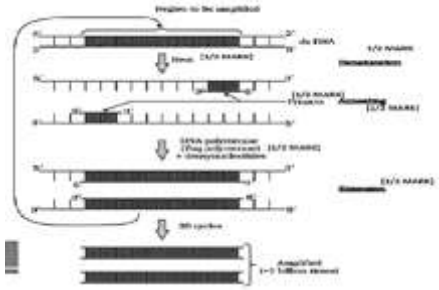
(iv) LH surge induces rupture of Graafian follicle / the release of ovum /ovulation.

65. **(A) (i)** A bacterial cell is made competent by treating it with a specific concentration of a divalent cation such as calcium, which increases the efficiency with which DNA enters the cell through pores in its cell wall.

(ii) - Denaturation, DNA is heated to a high temperature resulting in the separation of two strands of DNA

- Annealing, two primers are annealed to each of the single-stranded template DNA.

- Extension , enzyme Taq polymerase extends the primers using the nucleotides provided in the reaction and the genomic DNA as template.



OR

(B) (i) Transgenic animals: Animals that have had their DNA manipulated to possess and express an extra (foreign) gene are known as transgenic animals.

(ii) Common reasons to produce transgenic animals are :

- Normal physiology and development, Transgenic animals can be specifically designed to allow the study of how genes are regulated and how they affect the normal functions of the body and its development.

- Study of disease, Many transgenic animals are specially made to serve as models for human diseases so that investigation of new treatments for diseases is made possible.

-Biological products, Transgenic animals that produce useful biological products can be created

- Vaccine safety, Transgenic mice are being developed for use in testing the safety of vaccines before they are used on humans.

- Chemical safety testing, Transgenic animals are made that carry genes which make them more sensitive to toxic substances than non-transgenic animals.

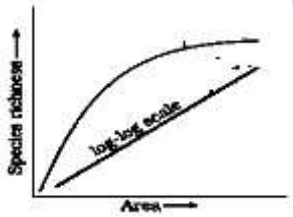
66. (A) (i)

-Tropical latitudes have remained relatively undisturbed for millions of years and thus had a long evolutionary time for species diversification

-Tropical environments are less seasonal more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity

-More solar energy is available in the tropics which contributes to higher productivity which leads to greater species diversity.

(ii)



- Alexander von Humboldt
- Within a region species richness increased with increasing explored area but only up to a limit.

OR

(B) (i)

-Habitat loss and fragmentation, Deforestation leads to habitat loss and ultimately causing extinction of animals and plants / When large habitats are broken into small fragments that also leads to population decline / mammals and birds with large territories and certain animals with migratory habits are badly affected.

- Overexploitation, overexploitation of natural resources by humans leads to extinction of many species / For example overexploitation of Steller's sea cow or passenger pigeon or many marine fishes led to their extinction.

- Alien species invasions, When alien species are introduced unintentionally or deliberately for whatever purpose some of them turn invasive and cause decline or extinction of indigenous species/For example Parthenium or Lantana or water hyacinth pose threat to indigenous species (or any other correct example)

-Co-extinctions, When a species becomes extinct the plant and animal species associated with it in an obligatory way also became extinct/For example unique assemblage of parasites and plant pollinator mutualism where extinction of one invariably leads to the extinction of the other

(any three points)

(ii) - Ex-situ conservation: Threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care.

- e.g. : Zoological parks, Botanical gardens, Wildlife safari parks, seed banks, pollen bank

(any two or any other relevant examples)

Section A

67. **(c)**
68. **(b)**
69. **(b)**
70. **(d)**
71. **(d)**
72. **(d)**
73. **(b)**
74. **(c)**
75. **(d)**
76. **(a)**
77. **(c)**
78. **(d)**
79. **(c)**
80. **(a)**
81. **(d)**
82. **(c)**

Section B

83. **(a)**
- The immunity will decrease.
- Immature lymphocytes will not differentiate into antigen - sensitive lymphocytes / development and maturation of T-lymphocytes does not take place.

OR

(b) (i)
- Virus infected cells secrete proteins called interferons.
- Interferons protect non-infected cells from further viral infection

(ii) Cytokine barriers.

84. **(a)** 7 amino acids, the genetic code is a triplet
(b) 7 amino acids, the genetic code is triplet

85. **(a)**
- Medical termination of pregnancy before full term / (Intentional or voluntary) termination of pregnancy before full term.
- Get rid of unwanted pregnancies either due to casual unprotected intercourse or failure of the contraceptive used during coitus or rapes, if pregnancy is harmful or even fatal either to the mother or to the foetus or both.

(any one reason)

OR

(b)
- Gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis-B, AIDS, any other correct answer

(any two disease)
- Itching, fluid discharge, slight pain, swelling in genital region, redness, any other correct answer

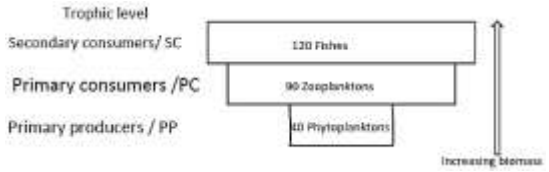
(any two symotoms)

86. **(a)** DNA ligase
(b) Transformation
(c) Same restriction EcoRI is used to cut both the vector DNA and alien DNA because it will produce complementary overhangs or sticky ends which will help in joining two DNA strands through hydrogen bonds.

87. **(a)** The clownfish gets protection from the predators due to the presence of stinging tentacles thus deriving benefit from sea
anemone, the sea anemone neither derive any benefit nor get harmed from the clownfish.

OR

(b)



(Award 1 mark for diagram of inverted pyramid of biomass, and 1 mark for correct trophic level)

Section C

88. After implantation of blastocyst finger-like projections appear on the trophoblast, called chorionic villi, which are surrounded by the uterine tissue, and maternal blood, the chorionic villi and uterine tissue become interdigitated with each other, and form a structural and functional unit between developing embryo or foetus and maternal tissue or body called placenta.

89. **(a)** True breeding pea plant varieties were selected, distinct contrasting characters were selected for different traits, artificial (self and cross) pollination was conducted carefully, large sample size was used, results were confirmed by performing experiments for several generations, any other correct point
(any two reasons)

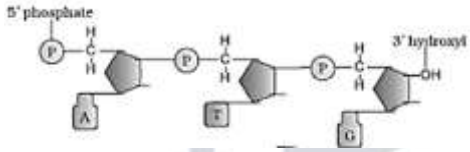
(b) When two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters.

90. **(a)**

(a) Phosphoester linkage/ Phosphoester bond

(b) Phospho-di-ester linkage / Phospho-di-ester bond

(b) Two



(c)
Ends correct sugar phosphate backbone correct nitrogenous bases

91. - The sewage is constantly agitated mechanically and air is pumped into it
- This allows the vigorous growth of useful microbes into flocs (masses of bacteria associated with fungal hyphae to form mesh like structures
- While growing these microbes consume the major part of the organic matter in the effluent
- This significantly reduces the Biochemical Oxygen Demand or BOD

92. **(a)** Wind pollination or Anemophily

(b) To trap air-borne pollen grains

(c) Pollen grains are light and, non-sticky

(d) As they need not attract insects or birds or bats/ facilitate the flow of wind

93. **(a)** Removal of Lantana allows other plants to grow, due to which herbivores population increases and that helps to restore the tiger population

(b) Lantana being invasive does not allow other plants to grow in its surroundings, this will decrease in herbivore population which can in turn cause decline in the tiger population.

94. - Advantage of Green revolution:
- Increase in the production of crops, support more population in terms of food
(any one advantage)
- Disadvantages of Green revolution:
- Use of agrochemicals (fertilisers and pesticides) led to the pollution of soil or water in long run (biomagnification)
- Crop management practices such as irrigation is expensive
- Agrochemicals were too expensive
- Led to increase in soil salinity
- Agrochemicals reduce natural soil fertility
- Crops become dependent on fertilisers & pesticides
- Or any other correct answer
(any two disadvantages)

Section D

95. (a) (i) Human and Macaque = Divergent evolution.

(ii) Human and Frog = Divergent evolution.

(b) Biochemical similarities in haemoglobin suggests common ancestry.

(c) (i) Macaque is more closely related to humans than lamprey, because the number of amino acid differences between human and macaque is less / human and macaque have more biochemical similarities in the structure of haemoglobin than human and lamprey.

OR

(c) (ii) Dog is more closely related to human than frog, because the number of amino acid differences between human and dog is less / dog and human have more biochemical similarities in the structure of haemoglobin than human and frog.

96. (a) As opiodis are generally taken intravenously and use of contaminated needles or contaminated injections increases the chances of hepatitis B (liver diseases).

(b) Direct drug related disease means diseases due to overdoses of opioids / fatal overdose of opioids.

(c) (i) - Papaver somniferum

- Latex

OR

(c) (ii) Drop in academic performance, unexplained absence from school or college, lack of interest in personal hygiene, withdrawal, isolation, depression, fatigue, aggressive, rebellious behaviour, deteriorating relationships with family and friends, loss of interest in hobbies, change in sleeping and eating habits, fluctuations in weight, appetite, stealing, mental and financial destress, or any other correct point.
(any two signs)

Section E

97. (a) (i) After entering one of the synergids the pollen tube releases the two male gametes into the cytoplasm of the synergid, one of the male gametes moves towards the egg cell and fuses with its nucleus thus completing the syngamy to form zygote, the other male gamete moves towards the two polar nuclei located in the central cell and fuses with it causing triple fusion to form Primary endosperm nucleus (PEN) or Primary endosperm cell (PEC).

(ii) Primary endosperm cell (PEC) and develops into the endosperm, while the zygote develops into an embryo.

OR

(b) (i)

- Each testicular lobule consists of 1-3 highly coiled seminiferous tubules, in which sperms are produced.
- Two types of cells
- Male germ cells/ spermatogonia, undergo meiotic divisions finally leading to sperm formation
- Sertoli cells, provide nutrition to the germ cells.

(ii)

- GnRH acts at the anterior pituitary gland, and stimulates secretion of (two) gonadotropins,
- luteinising hormone (LH)
- follicle stimulating hormone (FSH).

98. (a)

- RNA interference or RNAi
- Steps of RNAi
- Using Agrobacterium vectors nematode-specific genes were introduced into the host plants
- The introduction of DNA was such that it produced both sense and anti-sense RNA in the host cells
- Two RNA's being complementary to each other form a double stranded RNA (dsRNA)
- This initiated RNA i and thus silenced the specific mRNA of the nematode. (consequently the parasite could not survive in a transgenic host expressing specific interfering RNA)

OR

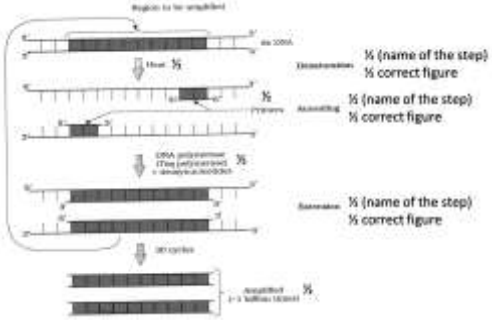
(b)

• Each cycle in PCR has three steps:
Denaturation, Annealing, Extension

- Denaturation: DNA subjected to higher temperature, the two strands of DNA separate due to broken hydrogen bonds between nitrogenous bases

- Annealing: Two sets of primers, which are complementary attach on 3' end of both template strands.
- Extension: the new strand of DNA is formed using thermostable Taq polymerase enzyme (derived from Thermus aquaticus bacterium), extends the primers and the nucleotides provided in the reaction and the genomic DNA act as the template.
- The process of replication of DNA is repeated 30 times the segment of DNA is amplified 1 billion times i.e. 1 billion copies are made.

(Marks to be allotted if the key points are depicted in the form of the diagram)



99. (a) (i) A population growing in a habitat with limited resources initially shows a lag phase, followed by phases of acceleration and deceleration and, finally a asymptote when the population density reaches the carrying capacity.

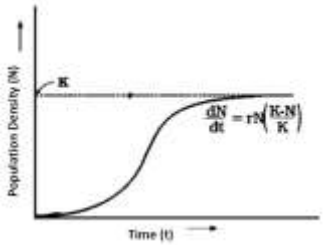
(ii) Equation:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

(N = population density at time t, r = intrinsic rate of natural increase, k = carrying capacity)

(iii) Logistic growth curve / Verhulst - Pearl Logistic Growth curve/sigmoid growth curve/S-Shaped curve.

Correct graphical plot of logistic growth curve.



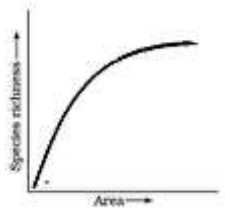
OR

(b) (i)

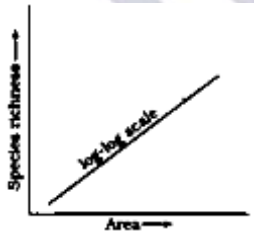
• Within a region species richness increases with increasing explored area but only upto a limit

• Nature of the graph - rectangular hyperbola.

(ii)



Or



(any one graph)

(iii) Correct equation -

$S = CA^Z / \log S = \log C + Z \log A$

(S = Species richness, A = Area, Z = Slope of the line (regression coefficient), C = Y-intercept)

SECTION – A

100. (d)

101. (d)

102. (d)

103. (c)

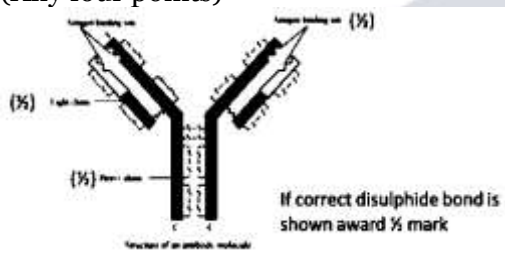
104. (c)

105. (c)

106. **(d)**
107. **(b)**
108. **(a)**
109. **(c)**
110. **(c)**
111. **(a)**
112. **(d)**
113. **(a)** Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
114. **(c)** Assertion (A) is true, but Reason (R) is false.
115. **(d)** Assertion (A) is false, but Reason (R) is true.

SECTION B

116. **(a)** -Each antibody molecule has four peptide chains/an antibody molecule is represented as H_2 L_2
- Two small chains called light chains
- two longer chains called heavy chains
- It has an antigen binding site at N end (amino end)
- It has disulphide bond between different parts of proteins or proteins of different chains
(Any four points)



OR

(b) - Ensuring availability of HIV free blood in blood banks
- Ensuring the use of only disposable needles and syringes in public and private hospitals and clinics
- Free distribution of condoms.
- Controlling drug abuse.
- Advocating safe sex.
- Promoting regular check-ups for HIV in susceptible populations.
- Preventing infection during blood transfusions in patients.
- Monitoring of pregnant women for HIV
(Any four Measures)

117. **(a)** - Diagram (ii) is the correct replicating fork
- The DNA - dependent DNA polymerase catalyse polymerisation only in one direction, that is $5' \rightarrow 3'$
- On one template strand with polarity $3' \rightarrow 5'$ DNA synthesis is continuous and on other template strand with polarity $5' \rightarrow 3'$ DNA replication is discontinuous.
(b) DNA ligase

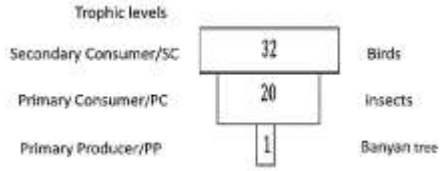
118. **(a)** - Amniocentesis: Some of the amniotic fluid of the developing foetus is taken to analyse the fetal cells and dissolved substances.
- Misuse: Sex-determination of foetus which lead to increase in female foeticide OR
(b) - Gonorrhoea, chlamydiasis, genital warts, trichomoniasis, syphilis, genital herpes, hepatitis-B, AIDS
(Any two diseases)
- Pelvic inflammatory diseases (PID), abortions, still births, ectopic pregnancies, infertility or even cancer of the reproductive tract
(Any two complications)

119. **(a)** Taq polymerase
(b) It forms overhanging stretches called sticky ends, which facilitates hydrogen bond formation with their complementary cut parts by DNA ligase.
(c) Escherichia coli/E.coli

120. **(a)** Fig species can be pollinated only by its 'partner' wasp species and no other species, the female wasp uses the fruit not only as an oviposition (egg-laying) site, but also uses the developing seeds within the fruit for nourishing the larvae, the wasp pollinates the fig inflorescence while searching for suitable egglaying site.

OR

(b) Ecological pyramid of number.



SECTION C

121. **The signals of parturition originate from the fully developed fetus and the placenta, which induce mild uterine contractions called fetal ejection reflex, this triggers release of oxytocin from the maternal pituitary, Oxytocin acts on the uterine muscles and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin, the stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions which leads to expulsion of the baby out of the uterus through the birth canal.**

122. Disorder is Down's Syndrome

• Symptoms: - Short statured with small round head
- furrowed tongue
- partially open mouth.
- palm is broad with characteristics palm crease
- retarded physical growth/psychomotor development/mental development.

(Any two symptoms)

123. **(a)** BOD - Biochemical Oxygen Demand

(b)

• The amount of the oxygen that would be consumed if all the organic matter in 1 litre of water were oxidised by bacteria.

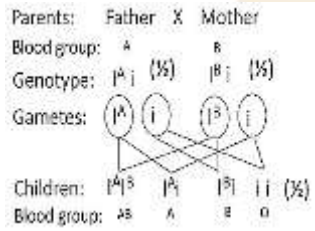
• The greater the BOD of waste water more is its polluting potential

124. - Made crops more tolerant to abiotic stresses (cold, drought, salt, heat).
- reduced reliance on chemical pesticides (pest resistant crops).
- helped to reduce post-harvest losses.
- increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil).
- enhanced nutritional value of food (eg. golden rice i.e. vitamin 'A' enriched rice).
- tailor-made plants to supply alternative resources to industries in the form of starches, fuels and pharmaceuticals.

125. **(a)** Three alleles

(b) Co-dominance.

(c) Yes, they can have a child with 'O' blood group



126. - The Amazon rain forest is being cut and cleared for cultivating soya beans or for conversion of grasslands for raising beef cattle which threaten survival of many species.

- When large habitats are broken up into small fragments mammals and birds requiring large territories, and certain animals with migratory habits are badly affected leading to their extinction or population decline.

127. **(a)** The given type of pollination prevents inbreeding depression/ prevents loss of fertility/promote hybrid vigour/ improve genetic variability

(b) - The plant will not show geitonogamy
- because in this flowering plant pollen release and stigma receptivity are not

synchronised/as the flowers are present on different plants.

SECTION D

128. **(a) (iii)** Greater, Greater

(b) (i) Divergent evolution

(ii) Divergent evolution

- both indicates common ancestry as in both cases cytochrome C is the respiratory pigment.

(c) (i) Convergent evolution: Different structures evolving for the same function and hence having similarity.

OR

(c) (ii) Divergent evolution: Same structure developed along different directions due to adaptations to different needs.

129. **(a)** 15 – 16 years or Adolescence period (12-18 years of age)

(b) Clearing of forest / deforestation / Narco-deforestation / extinction of species / promotes monoculture that will further lead to loss of

(c) (i)

• Inflorescence / flower tops / leaves / resin.

• Affects the cardiovascular system of the body/any other correct effect

OR

(c) (ii) - Erythroxylum coca

- Causes hallucinations.

SECTION E

130. **(a)**

• Animals that have had their DNA manipulated to possess and express an extra gene are known as transgenic animals.

• Areas of benefits are

- Normal physiology and development, Transgenic animals can be specifically designed to allow the study of how genes are regulated and how they affect the normal functions of the body and its development like study of complex factors involved in growth such as insulinlike growth factor.

- Study of disease, transgenic animals are used to increase understanding of how genes contribute to the development of disease like cancer or cystic fibrosis

- Biological products, transgenic animals that produce useful biological products can be created and the products can be used to treat diseases like (2-1-antitrypsin) human protein can be produced to treat emphysema / Rosie, produced human protein enriched milk containing alpha - lactalbumin which is a balanced product for human babies or any other examples.

- Vaccine safety, transgenic mice are being developed for use in testing the safety of vaccines before they are used in humans like transgenic mice are being used to test the safety of the polio vaccine (or any others example)

- Chemical safety testing, transgenic animals are modified to carry gene which make them more sensitive to toxic substances than non-transgenic animals so transgenic animals are exposed to the toxic substances and the effects studied

(Any four points)

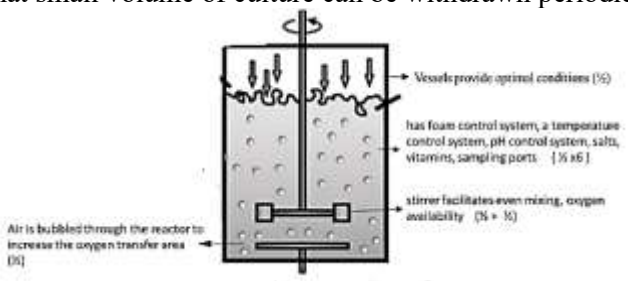
OR

(b) - Vessels or large containers which provide optimal conditions to produce the desired product.

- The stirrer facilitates even mixing, and oxygen availability throughout the bioreactor.

- Air is bubbled through the reactor to increase the oxygen transfer area.

- It has foam control system, a temperature control system, pH control system, salts, vitamins, sampling ports so that small volume of culture can be withdrawn periodically.



(Marks to be allotted if the key words are depicted in the diagram in lieu of explanation)

131. **(a) (i)** When resources in the habitat are unlimited each species has the ability to realize fully its innate potential to grow in number, the population grow in an exponential or geometric fashion, It results in a J-shaped curve when we plot population density in relation to time.

(ii) $dN/dt = (b - d)xN/dN/dt = rN/N_t = N_0e^{rt}$

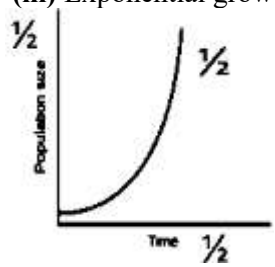
r = intrinsic rate of natural increase

N = size of the population

b = birth rate

d = death rate

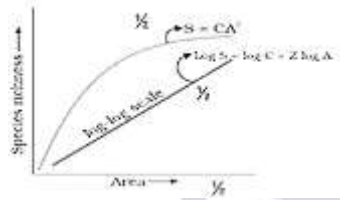
(iii) Exponential growth curve



OR

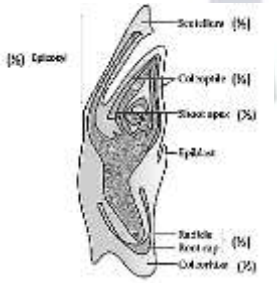
(b) (i)- Within a region species richness increases with increasing explored area, but only up to a limit

(ii) $\log S = \log C + 2\log\ A/S = CA^Z$



(iii)

132. **(a) (i)** Embryo of a monocotyledon seed has one cotyledon called scutellum, situated towards one side (lateral) of the embryonal axis at its lower end, the embryonal axis has the radical and root cap, enclosed in an undifferentiated sheath coleorhiza, The portion of the embryonal axis above the level of attachment of scutellum is epicotyl, and a few leaf primordia enclosed in a hollow foliar structure the coleoptile



(Marks to be allotted if the key point are depicted in the diagram in lieu of explanation.)

(ii)

• Some of the Nucellar cells surrounding the embryo sac start dividing and protrude into the embryo sac and develop into embryos.

• Apomixis/Polyembryony

OR

(b) (i) - Rete testis, The seminiferous tubules of the testis open into the Vasa efferentia through rete testis

- Vasa efferentia, leave the testis and open into epididymis located along the posterior surface of each testis
- Epididymis, the epididymis leads to Vas deferens
- Vas deferens, this ascends to the abdomen and loops over the urinary bladder.

(ii) FSH acts on Sertoli cells, stimulates secretion of some factors which help in the process of spermiogenesis (which is a part of spermatogenesis).

SECTION A

133. **(b)**

134. **(c)**

135. **(b)**

136. **(d)**
137. **(a)**
138. **(d)**
139. **(c)**
140. **(c)**
141. **(b)**
142. **(c)**
143. **(b)**
144. **(b)**
145. **(c)**
146. **(a)**
147. **(a)**
148. **(a)**

SECTION B

149. **(a)** One petal of *Ophrys* bear uncanny resemblance to the female of the bee in size colour and marking, male bee pseudo-copulates with the flower considering it as a female and during the process is dusted with pollen from the flower.

OR

(b) Fragmentation, leaching, Catabolism, humification, Mineralisation
Humification: It leads to accumulation of a dark coloured amorphous substance which is called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate.

150. **(a)** Gene cloning / Amplification
(b) **(i)** EcoR I to cut both the plasmid and alien DNA
(ii) Cutting with Same restriction enzyme will yield sticky ends at the end of both DNA which can be joined together by DNA ligase

151. **(a)** **(i)** Provides antibodies/provides IgA/provide nutrition/ Provides passive immunity
(ii) Colostrum

OR

(b) **(i)** Allergy
(ii) IgE
(iii) Histamine and Serotonin

152. **(a)** six
(b) • 10
• 0.34 nm/3.4 A°
(c) The plane of one base pair stack over the other in double helix additionally confirms stability of helical structure of DNA

153. **(a)**
• To check indiscriminate and illegal female foeticide
• First trimester/ 12 weeks/ first three months

OR

(b)
• Pelvic Inflammatory disease
• Human immunodeficiency Virus /HIV, Genital herpes, Hepatitis B

SECTION- C

154. **(a)** Self incompatibility, It is a Genetic mechanism to prevent self-pollen (from the same flower or other flower of same plant) from fertilising the ovules by inhibiting pollen germination or pollen tube in the pistil/ non-synchronisation of pollen release and stigma receptivity, Either the pollen is released before the stigma becomes receptive or stigma becomes receptive much before the release of pollen
(b) It would have led to inbreeding depression

155. **(a)** The Nile perch introduced into Lake Victoria in East Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of Cichlid fish in the lake, the environmental damage caused and threat posed to our native species by invasive weed species like carrot grass (Parthenium) or Lantana or water hyacinth (Eicchornia),Introduction of the African catfish Clarias gariepinus for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers

(b) High degree of endemism and high levels of species richness

156. **(a)** Haplo-diploid sex determination mechanism

(b) **(i)** Mitosis

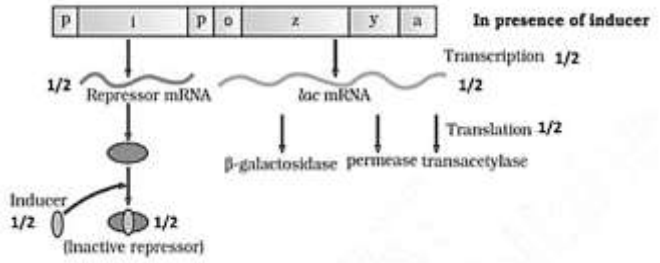
(ii) 16

(iii) 32

(c) Sex: Male

Chromosome Number: 16

157. Lactose transported into the cell through permease, in the presence of an inducer lactose the repressor is inactivated by interaction with the inducer, this allows RNA polymerase access to the promoter and transcription proceeds



158. **(a)** - Inner wall: Endometrium, endometrium undergoes cyclical changes during menstrual cycle/ thickening of endometrium is required for pregnancy

- Middle layer: Myometrium, myometrium exhibits strong contraction during delivery of the baby

(b) The edges of the infundibulum in ovary possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation.

159. **(a)** Sedimented bacterial flocs in settling tank is called activated sludge

(b) In anaerobic sludge digester bacteria digest the bacteria and the fungi in the sludge, during this digestion bacteria produce a mixture of gases (such as methane, hydrogen sulphide and carbon dioxide)

160. **(a)**Produces human protein enriched milk (2.4 gm/litre), the human alpha lactalbumin is more nutritionally balanced for human babies

(b) To treat emphysema

SECTION D

161. **(a)** Mutation

b A/Greater the evolutionary distance, greater are the differences in the nitrogenous bases/ or D/ Lesser the evolutionary distance, Lesser are the differences in the nitrogenous bases

(c) **(i)** Divergent Evolution, As both of them diverge from same ancestor and possess homologous structure.

OR

(c) **(ii)**

Divergent Evolution	Convergent Evolution
They have different ancestor	They have common ancestor
They possess homologous structure	They possess analogous structure
Organ possesses same structure but different function	Organ possesses different structure but same function

162. **(a)** Number of men taking treatment was higher than women/ 1 woman out of 18 was treated/ 1 man out of 7 was treated/ 1 in 11 persons was addicted to Cannabis sativa or Papaver somniferum / drug user have increased by 20% / 292 million people were consuming drugs in 2022

(b) Contaminated needles sharing between drug addicts transmits diseases like Hepatitis B and HIV. Both diseases are primarily caused by viruses.

(c) (i) Cannabis sativa

OR

(c) (ii) Papaver somniferum

SECTION E

163. **(a) (i)**- Bacillus thuringiensis forms Bt toxin protein which exist as inactive protoxins hence bacteria are not killed

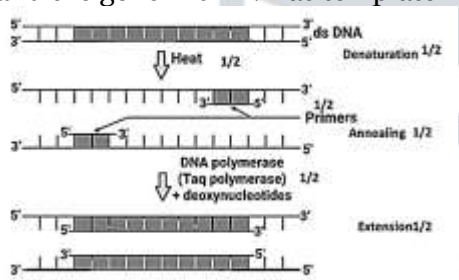
-once the insect ingests inactive protoxin, it gets converted to its active form due to alkaline pH of the gut of larva which solubilise the crystals, activated toxin binds to surface of midgut epithelial cells, cause cell swelling and lysis and eventually death of insect

(ii) Specific Bt toxin genes were isolated from Bacillus thuringiensis, and expressed in cotton, when the cotton bollworm ingests plant part, it will not survive

OR

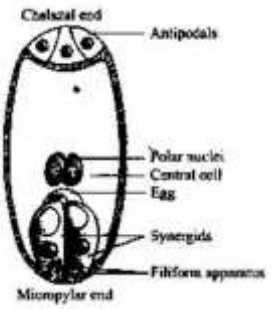
(b) (i)

- Denaturation, two strands of DNA are separated at high heat or temperature
- Annealing of primer, two set of Primer binds to DNA
- Extension, Enzyme Taq polymerase extend the primer using the nucleotide provided in the reaction and the genomic DNA as template



(ii) The amplified fragments can now be used to ligate with a vector for further cloning/ DNA fingerprinting, recombinant protein synthesis/ Diagnosis of diseases

164. **(a) (i)** Three cells are grouped together at the micropylar end of embryo sac , constitute the egg apparatus, the egg apparatus in turn consists of two synergids , one egg cell, the synergids have special cellular thickenings at the micropylar tip called filiform apparatus, three cells are at the chalazal end and are called the antipodals, the large central cell has two polar nuclei, thus a typical angiosperm embryo sac at maturity though 8 -nucleate is 7 -celled.



(Award marks for correct diagram with 8 labeling)

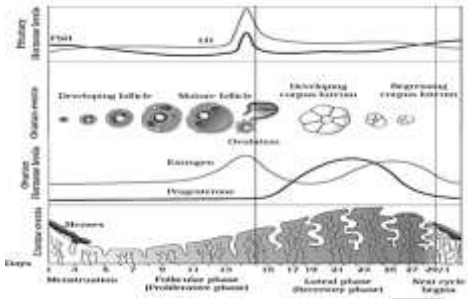
(ii)One of the two male gametes fuses with the two polar nuclei located in the central cell to produce a triploid primary endosperm nucleus (PEN).

OR

(b)

Phases of Menstrual cycle	Pituitary hormones	Ovarian hormone	Ovary	Uterus
(1) Menstrual phase/day 1-5	Low FSH and LH	Low Progesterone and Estrogen	Follicle start to develop	Lining of endometrium shed and expelled as menstrual flow
(2) Follicular/Proliferative phase/day 6-13	FSH and LH rises	Estrogen rises and low progesterone	Follicle mature	Endometrium to thicken
(3) Ovulatory phase/day 14-15	LH surge (about 14th day)	Increase level of estrogen and low progesterone	Graafian follicle ruptures	Uterus lining further thickens
(4) Luteal phase/day 16-28	FSH and LH level begins to decline	High progesterone and low Estrogen	Ruptured follicle transformed into the corpus luteum which produce progesterone and estrogen	Uterus lining continues to thicken for implantation

(NOTE: If all phases of menstrual cycle are correct then award 1 mark, Award $\frac{1}{2}$ marks if both ovarian and pituitary hormone levels are correct in each phase and $\frac{1}{2}$ marks for changes in both ovary and uterus for each phase)

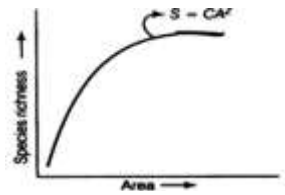


(NOTE: If all phases of menstrual cycle are correct then award 1 mark, Award $\frac{1}{2}$ marks if both ovarian and pituitary hormone levels are correct in each phase and 1/2 marks for changes in both ovary and uterus for each phase)

165. (a) He observed that within a region species richness (the number of different species) increase with increasing area, only up to a limit

(ii)

•



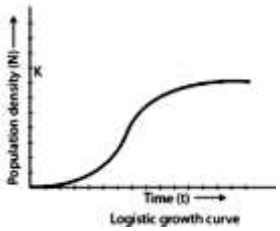
(**1/2** mark each for both axis and **1** mark for correct graph)

• *Z* shows relationship between species richness and area/ Regression coefficient/ slope of graph

OR

(b) (i) A population growing in a habitat with limited resources show initially a lag phase, followed by

phases of acceleration, and deceleration and finally an asymptote, when the population density reaches the carrying capacity



(ii) $DN/dt = rN(K - N/K)$
Where N = Population density at time t
r = Intrinsic rate of natural increase
K = Carrying capacity/ maximum possible numbers in a given habitat

SECTION A

166. **(c)**
167. **(d)**
168. **(d)**
169. **(b)**
170. **(b)**
171. **(a)**
172. **(c)**
173. **(b)**
174. **(d)**
175. **(b)**
176. **(a)**
177. **(b)**
178. **(c)**
179. **(a)**
180. **(a)**
181. **(a)**

SECTION B

182. **(a)** Basmati rice

Basmati rice -claimed as an invention by American company was derived from varieties used by Indian farmers for centuries by crossing it with semi-dwarf varieties.

OR

(b) Two purposes of GEAC:
- GEAC makes decision regarding the validity of GM research,
- GEAC also ensures the safety of introducing GM - organisms for public services.

183. **(a)** Signals for parturition arise from fully developed foetus and placenta which induce mild uterine contractions, called foetal ejection reflex, this triggers release of oxytocin from maternal pituitary, which act on uterine muscle and causes stronger uterine contractions.

OR

(b) **(i)** Menstrual cycle ceases / menopause occur around 50 years of age.
(ii) During oogenesis Meiosis I and II are unequal divisions which form one large cell and a smaller polar body / The unequal cell formation will ensure that the large cell has more cytoplasm and more nutrient reserve for better survival of the zygote.
Meiosis I and II are equal divisions in spermatogenesis.

184. **(a)** Dryopithecus / Ramapithecus (Any one primate)
(b) Tanzania/ Ethiopia (Any one place)
(c) Australopithecines
(d) Homo erectus

185. **(a)**

• The human body produces antibodies against the vaccine which would neutralise the pathogenic agents during actual infection, Vaccines also generate memory B and T cells.
• Vaccination will prevent occurrence of diseases by quickly recognising the pathogen and producing antibodies hence making society disease free.

OR

(b) Mucus coating of the gastrointestinal tract/ Acid in the stomach/saliva in mouth

186. **(a)** Klinefelter's syndrome

(b) Development of breasts or Gynaecomastia / underdeveloped masculine character/ sterility/ tall stature with feminised character.

(c) Aneuploidy/ Non disjunction or Failure of segregation of chromatids during cell division results in gain of extra X chromosome in male / trisomy of sex chromosome.

SECTION C

187. **(a)** Oral Pills

Merits - Effective with less side effects/reversible/ cost effective/ user friendly.

Demerits - Have side effects when taken for a long time/ Pills if not taken and not repeated in a particular pattern may fail to prevent conception/wrong usage may promote conception

Surgical Method :

Merits - Highly effective / Block gamete transport

Demerits - Not reversible / Can affect health if not performed in hygienic conditions.

(b)IUD's prevent conception by

- Increase phagocytosis of sperms.
- Some suppress sperm motility and fertilizing capacity of sperms by releasing Cu^{++}ions.
- Hormone releasing IUD's make uterus unsuitable for implantation and cervix hostile to sperms.

188. **(a)**This is adaptive radiation leading to divergent evolution.

Example - Many varieties of Darwin's finches on the same island arose from the original seed-eating finches with altered beaks enabling them to become insectivorous and vegetarian finches / A number of marsupials different from each other evolved from an ancestral stock but all within the Australian island /or any other relevant example.

(b)

• Example-Evolution of Placental mammals and Australian Marsupials or any other corresponding example of these categories respectively.
• Convergent evolution.

189. **(a)** Lysine - Serine - Proline - Tyrosine

AAC UCC CCC UAC

(b) Lysine - Proline - Proline – Tyrosine

(c) UUG AGG GGG AUG
UUG GGG GGG AUG

190. Typhoid - Sustained high fever $39-40°C/$ stomach-pain/ constipation.

Pneumonia- severe problems in respiration/in severe cases the lips and fingernails may turn grey to bluish in colour/ chills /cough

Malaria- If chills and high fever occurs in every $3-4$ days.

191. **(a)** Animals that have their DNA manipulated to possess and express an extra or foreign gene are known as transgenic animals.

(b)(i) Vaccine safety -

Transgenic mice are being developed for use in testing the safety of vaccines before they are used on humans. Transgenic mice are being used to test the safety of the polio vaccine.

(ii) Biological products -

Transgenic cow-Rosie produced human protein enriched milk (2.4 gram per litre). The milk contains human alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow milk or any other example.

192. **(a)**Large number of plants can be grown in short period of time, useful where sexual reproduction is not possible, plants without seeds can be multiplied, every plant has same genetic makeup.

(b) Any part of the plant or explant is grown in a test tube under sterile conditions, in nutrients medium (containing sucrose, vitamins, inorganic salts,amino acids, growth regulators like auxin and cytokinin etc)

(c) Banana, Apple, Tomato, etc.

193. In an aquatic ecosystem-Grazing food chain (GFC).

In a terrestrial ecosystem-Detritus food chain (DFC).

Differences -

Grazing Food Chain	Detritus food chain
Transfer of energy starts from producers in a food chain.	Transfer of energy starts from detritus /decomposing organic matter.
More energy flows through this.	Less amount of energy flows through this .
Energy obtained from Sun	Energy obtained from dead organic matter
Major conduit of energy in aquatic system	Major conduit of energy in terrestrial system

SECTION D

194. **(a)** • Sewage treatment plant

• used to treat sewage water before it can be released into water body.

(b) Air helps in growth of flocs (aerobic bacteria along with fungal filaments), which decompose organic matter in the sewage using oxygen.

(c)(i) Bacterial 'flocs' settle down to form activated sludge.

OR

(c) (ii) BOD is directly related to the measure of the organic matter present in water/ Greater the BOD more is the polluting potential

195. **(a)** A - Geitonogamy

B - Autogamy

(b)

-Anthers and stigma to be close to each other in a bisexual flower cleistogamous flower / closed flower / Pollen release and stigma receptivity at the same time

(Any two conditions)

(c)(i) Advantage → Assured seed set /no dependence on pollinators / pure breed can be obtained.

Disadvantage → No genetic variation / Inbreeding depression

OR

(c) (ii)

• Oxalis/ Viola or common pansy/ Commelina .

• Some flowers do not open at all /cleistogamy/ closed flower hence show autogamy.

SECTION E

196. **(a)**

-It should be able to generate its replica.

-Be chemically and structurally stable.
-Provide scope for slow changes(mutation) required for evolution.
-Able to express itself in the form of 'Mendelian Characters'.
DNA is double-stranded whereas RNA is single-stranded, DNA has thymine instead of uracil which is present in RNA and thus DNA is more stable, DNA has $2' - H$ group whereas RNA has $2' - OH$ group at every nucleotide which is reactive and easily degrades RNA, RNA is also catalytic, both RNA and DNA can mutate but RNA mutates faster than DNA.
Based on above points DNA molecule is preferred as an ideal genetic material .

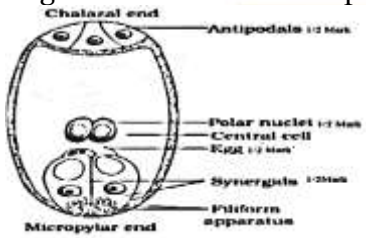
OR

(b) (i) Polygenic Inheritance-Inheritance of a trait that is controlled by three or more genes / the phenotype reflects contribution of all alleles (three or more) and effect of each allele is additive.
Pleiotropy - When a single gene shows multiple phenotypic expressions.
(ii) Dominance - In heterozygous pair of gene dominant allele is expressed over the recessive allele/ F1 progeny resemble either of the two parents which is dominant.
Codominance - In a pair of genes when both alleles express themselves/ F1 generation(one of the progeny) resembles both the parents.
Incomplete dominance - When in heterozygous state none of the allele is able to express itself and phenotype is in between/ Phenotype of F1 progeny is in between the two parent.

197. (a) (i)
A - Spermatozoa
B - Spermatid /Spermatozoa
C - Sertoli cells
D - Spermatogonium
(ii) Secondary spermatocyte - 23 chromosomes Spermatid - 23 chromosomes
(iii) Spermiogenesis - Process by which spermatids are transformed into spermatozoa.
Spermiation - Process by which sperm had their head embedded in Sertoli cells are released from seminiferous tubules.

OR

(b) (i) P-Megaspore mother cell
Q-Megaspores (four megaspores)
(ii) (I) Meiosis.
(II)
• Only one cell
• Monosporic development
(III) Three free nuclear division
(IV)
The mature female gametophyte has 3 cells at micropylar end - Egg apparatus (two synergids and one egg cell) with thickenings called filiform apparatus in synergids, three cells at chalazal end - Antipodals, large central cell with two polar nuclei, so it is 8-nucleated and 7-celled.



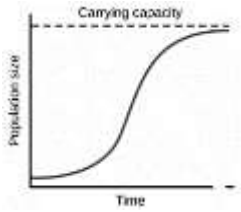
198. (a) (i) Alien species invasion - when alien species are introduced unintentionally or deliberately some of them turn invasive and cause decline or extinction of indigenous species.
I.Nile Perch - In Lake Victoria in East Africa Nile Perch caused extinction of 200 species of cichlid fish.
II. Lantana and Eichhornia - Caused environmental damage and threat to native species.
III. Clarias gariepinus - African catfish introduced for aquaculture purposes poses a threat to indigenous catfishes in our rivers.

(ii) Regions with high levels of species richness, high degree of endemism have been declared as biodiversity hotspots to conserve biodiversity.
In India - Indo-Burma, Himalaya , Western Ghats and Sri Lanka
(Any two regions)

OR

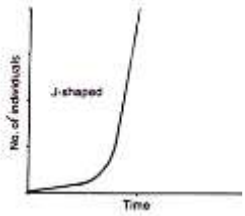
(b) (i) $dN/dt = rN\left[\frac{K-N}{K}\right]$

(ii)



Sigmoid growth curve

(iii)



J-shaped growth curve

(iv)

-Logistic Growth curve / Sigmoid growth curve is more realistic -A given habitat in nature has enough resources to support a maximum possible number beyond which further growth is not possible/ resources become limiting factor

SECTION A

199. (a)
200. (d)
201. (c)
202. (c)
203. (b)
204. (b)
205. (c)
206. (c)
207. (c)
208. (a)
209. (a)
210. (a)
211. (c)
212. (d)
213. (c)
214. (d)

SECTION B

215. (a) (i)

- Primary spermatocytes-2n / Diploid
- Secondary spermatocytes - n / Haploid.

(ii) In spermatogenesis- the first meiotic division produces two (functional) haploid daughter cells called secondary spermatocytes / produces two haploid daughter cells of equal size whereas in oogenesis the first meiotic division produces two daughter cells but one is a (larger) secondary oocyte and other daughter cell is first (smaller) polar body (non-functional) / produces two haploid daughter cells of unequal size.

OR

(b) (i) Trophoblast layer gets attached to the endometrium to help in implantation / helps in placenta formation /

forms chorionic villi (during placenta formation)

(ii) A structural and functional unit connecting the developing embryo and maternal body called as placenta.

216. **(a)** In Polygenic inheritance three or more genes control a single phenotypic trait (character) but in Mendelian inheritance a single gene controls a single character,

In Polygenic inheritance contribution of each allele is additive (quantitative) whereas in Mendelian inheritance it is only one dominant allele that expresses (qualitative).

OR

(b)

• Co-dominance, I^A and I^B when present together they both express their own type of sugars as AB blood group.

• Multiple allelism, I gene has 3 alleles (I^A, I^B, i) governing the blood group (though only 2 alleles govern the characters according to Mendelian inheritance).

217. • To prevent microbial growth

• Physiological barrier

• Saliva in mouth / acid (HCl) in the stomach (any one example).

218. - Animal cells

Microinjection, rDNA is directly injected into the nucleus of an animal cell / Disarmed Retroviruses, to deliver desirable gene into animal cells

- Plant cell

Biolistics / Gene gun, cells are bombarded with high velocity micro-particles of gold or tungsten coated with rDNA / using disarmed Ti plasmid vector or Agrobacterium Mediated Gene Transfer, used to deliver genes of interest into plants.

219. **(a)** A population growing in a habitat with limited resources shows initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote when the population density reaches the carrying capacity ' K ' this type of population growth is called as logistic growth curve equation

$dN/dt = rN(K - N)/K$

$N =$ population density at time t

$r =$ intrinsic rate of natural increase

$K =$ carrying capacity

OR

(b) Steps in the process of decomposition are:

• Detritivores breakdown detritus into smaller particles

• By the process of leaching water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts

• Bacterial and fungal enzymes degrade detritus into simpler inorganic substances

• Accumulation of dark coloured substance called humus takes place which undergoes decomposition at a very slow rate.

SECTION C

220. Pollen grains are light, pollen grains are non-sticky, well exposed stamens, large feathery stigma, single ovule in each ovary, numerous flowers packed into inflorescence, tassels to trap wind borne pollens, compact inflorescence, flowers are colourless, have no fragrance, have no nectar.

(Any three relevant adaptations)

221. Structure

Perimetrium is external thin membranous

Myometrium is middle thick layer of smooth muscle

Endometrium is inner glandular layer endometrium

Award half mark if structure of only 2 layers is described

Functions

-Perimetrium covers the uterus from outside

- Myometrium helps in muscle contractions during delivery of a baby

- Endometrium lines the uterine cavity

- Endometrium helps in cyclical changes during menstrual cycle

- Endometrium participates in implantation of the embryo.

(Functions of any two uterine layers)

222. • A replication fork is formed when DNA strands separate to make a small opening in the DNA helix.
• DNA strands are very long and cannot be separated in its entire length as it requires a lot of energy to uncoil, it provides template for the synthesis of new strands of DNA.

223. • Variation at genetic level / Allele sequence variation if more than one variant (allele) at a locus occurs in human population with a frequency greater than 0.01 / if an inheritable mutation is observed in a population at high frequency.
• It forms basis for genetic mapping of a genome, DNA fingerprinting, determining population and genetic diversities.
(Any two applications)

224. Species-specific, narrow spectrum insecticidal applications, no negative impacts on plants or mammals or birds or fish or non-target insects.

225. • Polymerase Chain Reaction / PCR
• To detect HIV/AIDS, to detect cancers, to detect genetic disorders, to detect covid-virus

226. • Predators are animal that hunt and eat other animals for food (or any other relevant explanation) whereas prey are animals that are killed and eaten by other animals.
• Predators act as conduits for energy transfer across trophic levels, Predators keep prey population under control, maintains species diversity by reducing the intensity of competition among competing prey species.
(Any two roles)

SECTION D

227. **(a)** Hardy-Weinberg equilibrium states that allele frequencies in a population are stable and is constant from generation to generation /the gene pool (total genes and their alleles in a population) remains constant/sum total of all the allelic frequencies is 1 (one).
(b) Sometimes the change in allele frequency is so different in the new sample of population that they become a different species, the original drifted population becomes founders and the effect is called as founder effect.
(c) (i) When a section of population migrates (gene migration) to another place the gene frequencies in the original as well as in the new population change thus deviating from Hardy-Weinberg equilibrium / New genes or alleles are added to the new population and these are lost from the old population thus deviating from Hardy -Weinberg equilibrium.

OR

(c) (ii) Mutation causes sudden change in the genes (genotype) in a population leading to evolution.

228. **(a)**
• Acquired Immunity or Active Immunity
• based on memory
(b) Two types of immune response are
-Humoral response, antibodies found in the blood.
• Cell mediated response, T-lymphocytes mediate CMI.
- Primary immune response, when our body encounters a pathogen for the first time.
- Secondary immune response, subsequent encounter with a same pathogen elicits a highly intensified response.
(c) (i)
- B-cells or B-lymphocytes produce an army of proteins (called antibodies) in response to pathogens into our blood to fight the pathogens.
- T-cells or T-lymphocytes themselves do not produce (secrete) antibodies but help B-cells to produce them.

OR

(c) (ii) Anamnestic response is highly intensified secondary immune response on subsequent encounter with same pathogen after primary response.

SECTION E

229. **(a) (i)** Seeds provide nutrition to the growing embryo,
Seeds help plants to overcome unfavourable conditions by dormancy,
Hard seed coat provides protection to the young embryo,
Being product of sexual reproduction they generate new genetic combinations leading to variations,
Seeds have better adaptive strategies for dispersal to new habitat.
(Any three advantages)

(ii) Perisperm is residual persistent nucellus whereas pericarp is the wall of the ovary that develops into a wall of the fruit.

(iii) Occurrence of more than one embryo in a seed, citrus/ Mango

OR

(b) (i)

• (Anterior) Pituitary gland

- In ovary development of follicles occur under the action of FSH (follicular phase),
- LH surge occurs during the mid-cycle and induces rupturing of Graafian follicle and release of the ovum (ovulation)/ LH surge causes ovulation
- Ovulation is further followed by luteal phase where corpus luteum is formed which secretes progesterone for maintenance of endometrium / the ruptured Graafian follicle is turned into corpus luteum which secretes progesterone.

(ii) Human Chorionic Gonadotropin / hCG, Human Placental Lactogen /hPL

(iii)

• Inner cell mass of the growing embryo or blastula or blastocyst contains stem cells,

• Which have the potency to give rise to all the tissues and organs.

230. **(a)** Made crops more tolerant to abiotic stresses, reduced reliance on chemical pesticides, helped to reduce post-harvest losses, increased efficiency of mineral usage by plants, enhanced nutritional value of food, make tailormade plants to supply alternative resources in industries (in form of starches/ fuels/ pharmaceuticals), for normal physiology and development, to study diseases, to get biological products, for vaccine safety, for chemical safety testing

(Any five benefits)

OR

• Insulin consists of two short polypeptide chains - A and B, that are linked by disulphide bridges.

• In humans insulin is synthesised as a prohormone which contains an extra stretch called C -peptide, insulin gets matured when C peptide is removed.

• Allergy or reactions to foreign protein.

231. **(a) (i)**

- Example: Fig tree and wasp,
- Fig tree can be pollinated only by 'wasp' and no other species,
- The female wasp uses the fruit for oviposition (egg-laying) site,
- Fig develops seed for nourishing wasp larvae and wasp help in pollination of the inflorescence,
- Since Fig tree and wasp are dependent on each other it is a mutualistic relationship,
- Both Fig tree and wasp have evolved for survival and co-evolution.

/

- One petal of Ophrys (Mediterranean Orchid) bears an uncanny resemblance to the female bee in size or colour or markings, male bee is attracted to what it perceives as a female and pseudocopulates with the flower, and during that process it is dusted with pollen from the flower, when the same bee pseudocopulates with another flower it transfers pollens, if the female bee's colour pattern change even slightly for any reason during evolution, pollination success will be reduced unless the orchid flower coevolves to maintain the resemblance of its petals to the female bee.

(ii) Endemism indicates species confined to a specific region and not found anywhere else.

Western Ghats and Sri Lanka, Indo-Burma, Himalayas.

(Any two)

OR

(b) (i) Population Density $N_{t+1} = N_t + [(B + I) - (D + E)]$

$= 500 + [(100 + 300) - (50 + 250)]$

$= 500 + 100$

Thus $N_{t+1} = 600$

(ii)

In situ conservation	Ex-situ conservation

(a)	This is an on-site conservation / Threatened plants and animals are conserved in their natural habitats	This is an off-site conservation / Threatened plants and animals are taken out from their natural habitat and placed in special setting where they can be protected and given special care.
(b)	It involves natural habitat of an organism.	It involves man-made habitats.
(c)	It is not suitable in case of rapid decline in the number of a species due to any factors.	It is best option in case of rapid decline in the number of species due to any factors.
(d)	Management and monitoring of target species is involved in this.	Sampling, storage and transfer of target species from natural habitats to manmade habitats is involved.