Model Answers to Descriptive Questions

This chapter deals with model answers to all types of descriptive questions such as Very Short Answer (VSA) type questions, Short Answers (SA) type questions and Long Answer (LA) type questions. The questions are randomly selected from different chapters, the answers are suggestive and written to provide approach and way of presentation.

ANSWERS TO VSA TYPE QUESTIONS

1. Mention two inherent characteristics of *Amoeba* and yeast that enable them to reproduce asexually.

Ans.
a. They are unicellular organisms.
b. They have a very simple body structure.

2. Why do we refer to offspring formed by asexual method of reproduction as clones?

Ans. Offspring formed by asexual reproduction are called clones because they are morphologically and genetically similar to the parent.

3. Although potato tuber is an underground plant part, it is considered as a stem. Give two reasons.

Ans.
a. The tuber has nodes and internodes.
b. Leafy shoots appear from the nodes.

4. Between an annual and a perennial plant, which one has a shorter juvenile phase? Give one reason.

Ans. An annual has a shorter juvenile phase. Since its entire life cycle has to be completed in one growing season, its juvenile phase is shorter.

5. Rearrange the following events of sexual reproduction in the sequence they occur in a flowering plant:

   Embryogenesis, Fertilisation, Gametogenesis, Pollination.

Ans. Gametogenesis, Pollination, Fertilisation, Embryogenesis

6. The probability of fruit set in a self-pollinated bisexual flower is far greater than a dioecious plant. Analyse.

7. Name the component cells of the 'egg apparatus' in an embryo sac.

Ans. Two synergids and an egg.

8. Name the part of gynoecium that determines the compatible nature of pollen.

Ans. Stigma.

9. Name the common function that cotyledons and nucellus perform.

Ans. Nourishment.

10. Complete the following flow chart

Ans. Generative cell

11. Indicate the stage where meiosis occurs (1, 2 or 3) in the flow chart.

Ans. 1 = meiosis

12. Name the parts of the gynoecium which develop into fruit and seeds.

Ans. Ovary develops into fruit; ovules develop into seeds.

13. In a case of polyembryony, if an embryo develops from the synergid and another from the nucellus which is haploid and which is diploid?

Ans. Synergid embryo is haploid and nucellar embryo is diploid.

14. Can an unfertilised, apomictic embryo sac give rise to a diploid embryo? If yes, then how?

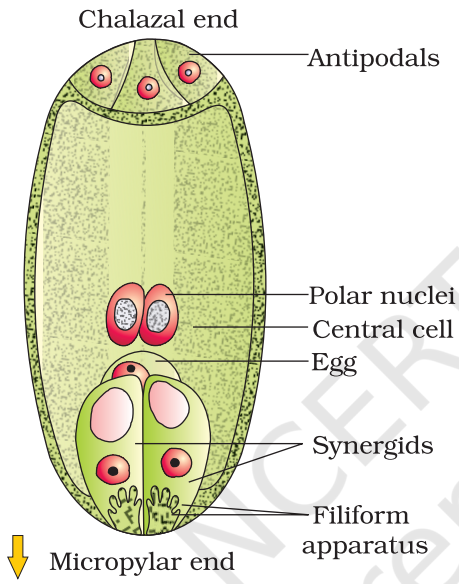
Ans. Yes, if the embryo develops from the cells of nucellus or integument it will be diploid.

15. Which are the three cells found in a pollen grain when it is shed at the three-celled stage?

Ans. One vegetative cell and two male gametes.

16. Draw the diagram of a mature embryo sac and show its 8-nucleate, 7-celled nature. Label the diagram.

Ans.



17. Which is the triploid tissue in a fertilised ovule? How is the triploid condition achieved?

Ans. The triploid tissue in the ovule is the endosperm. Its triploid condition is attained due to the fusion of two polar nuclei and one nucleus of male gamete (also referred to as triple fusion).

18. Is pollination and fertilisation necessary in apomixis? Give reasons.

Ans. No, they are not necessary. Apomixis is actually an alternative to sexual reproduction although the female sexual apparatus is used in the process. In apomicts, embryos can develop directly from the nucellus or synergid or egg. Therefore, there is no need for either pollination or fertilisation.

19. Given below are the stages in human reproduction. Write them in correct sequential order.

Insemination, Gametogenesis, Fertilisation, Parturition, Gestation, Implantation

Ans. Gametogenesis, Insemination, Fertilisation, Implantation, Gestation, Parturition.

20. What is the role of cervix of the human female system in reproduction?

Ans. Cervix helps in regulating the passage of sperms into the uterus and forms the birth canal to facilitate parturition.

21. Menstrual cycles are absent during pregnancy. Why?

Ans. The high levels of progesterone and estrogens during pregnancy suppress the gonadotropins which is required for the development of new follicles. Therefore, a new cycle cannot be initiated.

22. Female reproductive organs and associated functions are given below in column A and B. Fill in the blank boxes.

Column A	Column B
Ovaries	Ovalation
Oviduct	A
B	Pregnancy
Vagina	Birth

Ans. A — Fertilisation

B — Uterus

23. During reproduction, the chromosome number (2n) reduces to half (n) in the gametes and again resume the original number (2n) in the offspring, what are the processes through which these events take place?

Ans. Halving of chromosomal number takes place during gametogenesis and regaining the 2n number occur as a result of fertilisation.

24. Mention the essential of LH surge during menstrual cycle.

Ans. LH surge is essential for the events leading to ovulation.

25. Reproductive health refers only to healthy reproductive functions. Comment.

Ans. Reproductive health refers to a total well-being in all aspects of reproduction i.e., physical, behavioural, psychological, social and physiological.

26. Comment on the RCH programme of the government to improve the reproductive health of the people.

Ans. Creating public awareness regarding reproduction related aspects and providing facilities to build up a healthy society with added emphasis on the health of mother and child are the basic aims of the RCH programmes.

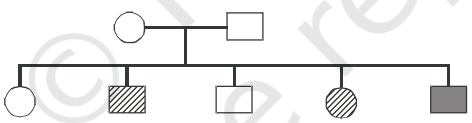
27. Males in whom testes fail to descent to the scrotum are generally infertile. Why?

Ans. If the testes fail to descend to the scrotum, gametogenesis could be inhibited, the process of spermatogenesis require a marginally lesser ambient temperature than that in the abdominal cavity.

28. A progeny of F_1, is crossed with the homozygous recessive parent. What is this cross called? Work out how is it useful?

Ans. When a progeny of F_1 is crossed with the homozygous recessive parent, it is called test cross. Such a cross is useful to determine the genotype of an unknown i.e., whether it is heterozygous, or homozygous dominant for the trait.

29. A pedigree chart given below, present a particular generation which shows a trait irrespective of sexes (i.e., present in both male and female). Neither of the parents of the particular generation shows the trait. Draw your conclusion on the basis of the pedigree.



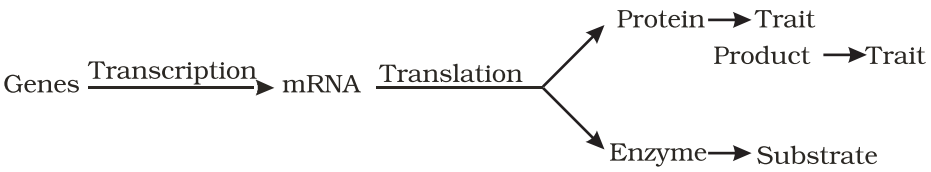
Ans. The trait is autosome linked and recessive in nature. Both the parents are carrier (i.e. heterozygous) hence among offspring few show the trait irrespective of sex. The other offsprings are either normal or carrier.

30. In order to obtain the F_1 generation, Mendel pollinated a true-breeding, say, tall plant with a true-breeding dwarf plant. But for getting the F_2 generation, he simply self-pollinated the tall F_1 plants. Why?

Ans. Genotype of 50% of the offspring would resemble one parent and the rest the other parent. All the F_1 offsprings of the cross are heterozygous so allowing self pollination is sufficient to raise F_2 offspring. Also he intended to understand the inheritance of the selected trait over generations.

31. "Genes contain the information that is required to express a particular trait." Explain.

Ans. The genes present in an organism show a particular trait by way of forming certain product. This is facilitated by the process of transcription and translation (according to central dogma of genetics)



32. How are alleles of particular gene different? Explain its significance.

Ans. Alleles of a particular gene differ from each other on the basis of certain changes (i.e., mutations) in the genetic material (segment of DNA or RNA). Different alleles of a gene increases the variability or variation among the organisms.

33. In monohybrid cross of red and white flower, Mendel got only red flower. On setting the F_1 plants having red flower he got both plants with red and white flower. Explain the basis of using RR and rr symbols to represent the genotype of plants of parental generation.

Ans. On crossing red and white flower only red colour flower appeared in the F_1 generation. But the white colour flower again appear in the F_2 generation which is raised out of the F_1 individuals only. Mendel reasoned that there is a factor of each and every character. Accordingly, there has to be one factor(R) for red flower and other one factor (r) for white flower. In case, an organism possess only one copy of the gene then the possibility of reappearance of white flower in the F_2 generation of the given cross is not there. Also the ratio (3:1 of red and white) indicates that each organism must possess two copies of a particular gene.

34. For the expression of traits "Genes provide only the potentiality and the environment provides the opportunity". Comment, on the veracity of the statement.

Ans. Hint:

Phenotype =	Genotype	+	Environment
(Trait)	(potentiality)		(opportunity)

35. A, B,D are three independently assorting genes with their recessive alleles a, b, d respectively. A cross was made between individuals of Aa bb DD genotype with aa bb dd. Explain the type of genotypes of the offspring produced.

Ans. The given cross is Aa bb dd X aa bb dd
Accordingly the type of offspring produced would be

Aa bb DD ↓	X	aa bb dd ↓ (i) abd
(½) A b D		(½) Aa bb Dd
(½) a b D		(½) aa bb Dd

36. Sometimes cattle or even human beings give birth to their young ones that have extremely different sets of organs like limbs/position of eye(s) etc. Why?

Ans. There is a disturbance in co-ordinated regulation of expression of sets of genes associated with organ development.

37. In a nucleus, the number of RNA nucleoside triphosphates is 10 times more than the number of DNA nucleoside triphosphates, still only DNA nucleotides are added during the DNA replication, and not the RNA nucleotides. Why?

Ans. DNA polymerase is highly specific to recognise only deoxy ribonucleoside triphosphates. Therefore it cannot hold RNA nucleotides.

38. Name indicating their functions, a few additional enzymes, other than DNA polymerase and ligase, that are involved in the replication of DNA with high degree of processivity and accuracy.

Ans. (i) helicase – opens the helix
(ii) topoisomerases – removes the supercoiling of DNA
(iii) Primase: synthesises RNA primer
(iv) Telomerase: to synthesises the DNA of telomeric end of chromosomes.

39. When we say 'simpler organisms' or 'complex organisms' what are we referring to?

Ans. When we say simple or complex organisms we are talking in terms of evolutionary history of an organism. A simple organism is considered to be primitive and has simple thallus organisation. The level of complexity of metabolism is also low. On the other hand a complex organism refers to a more evolved form forming higher levels of structural and functional complexities. They are believed to have arisen from simple organisms.

40. How do we compute the age of a fossil?

Ans. To compute the age of a fossil, we use radiocarbon dating.

41. In a certain population, the frequency of three genotypes is as follows:

Genotypes:	BB	Bb	bb
frequency:	22%	62%	16%

What is the likely frequency of B and b alleles?

Ans. Frequency of *B* allele = all of *BB* + ½ of *Bb* = 22+31 = 53% frequency of *b* allele = all of *bb* + ½ of *Bb* = 16 + 31 = 47%

42. Among the five factors that are known to effect Hardy-Weinberg equilibrium, three factors are gene flow, genetic drift and genetic recombination. What are the other two factors?

Ans. Natural selection and mutation.

43. By what latin name the first human-like being, the homonid was known?

Ans. *Homo habilis.*

44. Among *Ramapithecus, Australopithecines* and Homo *habilis* - who probably did not eat meat?

Ans. *Homo habilis.*

45. The immune system of a person is suppressed. In the ELISA test, he was found positive to a pathogen.

a. Name the disease the patient is suffering from.
b. What is the causative organism?
c. Which cells of the body are affected by the pathogen?

Ans.
a. Acquired Immuno Deficiency Syndrome (AIDS)
b. Human Immuno deficiency virus (HIV)
c. Helper T-lymphocytes (TH)

46. What would happen to immune system, if thymus gland is removed from the body of a person?

Ans. Thymus is the primary lymphoid organ. In thymus gland, immature lymphocytes differentiate into antigen-sensitive lymphocytes. If thymus gland is removed from the body of a person, his immune system becomes weak. As a result the person's body becomes prone to infectious diseases.

47. Many microbial pathogens enter the gut of humans along with food. What are the preventive barriers to protect the body from such pathogens? What type of immunity do you observe in this case?

Ans.
(i) The mucus coating of the epithelium lining of the gut helps in trapping microbes entering the body.
(ii) Saliva in the mouth and hydrochloric acid in gastric juice secreted by stomach prevent microbial growth. This type of immunity is innate immunity.

48. What are interferons? How do interferons check infection of new cells?

Ans. Interferons are natural proteins produced by the cells of immune system in response to foreign agents such as viruses, tumor cells and parasites and protect non-infected cells from further infection.

Interferons inhibit the viral replication within host cells, activate natural killer cells and macrophages, increases antigen presentation to lymphocytes, and induce the resistance of host cells to viral infection. When the antigen is presented to matching T-cells and B-cells, these cells multiply and remove the foreign substance.

50. If a regular dose of drugs or alcohol is not provided to an addicted person, he shows some withdrawl symptoms. List any four such withdrawal symptoms.

Ans. The withdrawal symptoms are:

a. Anxiety
b. Shakiness
c. Nausea
d. Sweating

51. Millions of chickens were killed in West Bengal, Orissa and Maharashtra recently. What was the reason?

Ans. Millions of chicken were killed (culled) in West Bengal, Orissa and Maharashtra because they were found to be infected with H5N1 virus the causal organism of Bird Flu.

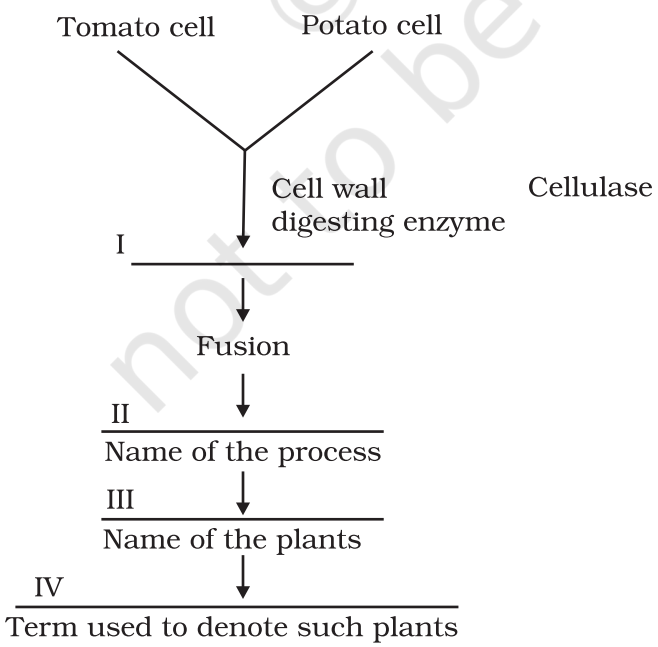
52. In animal husbandry, if two closely related animals are mated for a few generations, it results in loss of fertility and vigour. Why is it so?

Ans. The phenomenon being referred to is called 'Inbreeding Depression' and results in loss of fertility and vigour. This happens because the recessive alleles tend to get together and express harmful effects in the progeny.

53. Do you know of a man made cereal? Trace, how it was developed?

Ans. Triticale. It was developed by crossing *Triticum aestivum* (wheat and Secale cereale (rye)

54. Fill in the blanks



Ans. I Cellulase; II Somatic hybridization; III Potato; IV Somatic hybrid

55. What is meant by 'hidden hunger'?

Ans. Consumption of food deficient in nutrients particularly, micronutrients, proteins and vitamins is called hidden hunger

56. What is protoplast fusion?

Ans. The ability of protoplasts obtained from two different cells to fuse and form a hybrid protoplast is called protoplast fusion.

57. Name a microbe used for statin production. How do statins lower blood cholesterol level?

Ans. *Monascus purpureus* statins lower blood cholesterol level by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

58. What are nucleopolyhedroviruses being used for now a days?

Ans. Necleopolyhydroviruses are used for the biological control of insect pesto.

59. What are biofertilisers?

Ans. Biofertilisers are organisms that enrich the nutrients in the soil.

60. What would have happened if antibiotics were not discovered?

Ans. If antibiotics were not discovered bacterial and fungal diseases would not have been controllable.

61. Why is distillation required for producing certain alcoholic drinks?

Ans. Distillation increases the alcohol content in alcoholic drinks.

62. Give any two microbes that are useful in biotechnology.

Ans. *E.coli and Saccharomyces cenevisae*

63. What is Chakravarthy bug? Give its scientific name and its application?

Ans. Chakravarthy Bug is a super bug of Pseudomonas with multiple plasmid. They are helpful in removing oil spills.

64. Name any genetically modified crop.

Ans. Bt cotton.

65. List any two industrially important enzymes.

Ans. Lipase, Amylase.

66. Name an immune supressive agent?

Ans. Cyclosporin.

67. Give an example of a rod shaped virus.

Ans. Tobacco mosaic virus.

68. For producing a recombinant protein (for therapeutic purpose) in large scale, which vector would you choose – a low copy number or high-copy number?

Ans: High-copy number, because higher the copy number of vector plasmid, higher the copy number of gene and consequently, protein coded by the gene is produced in high amount.

69. Would you like to choose an exonuclease enzyme while producing a recombinant DNA molecule?

Ans: No, as exonuclease acts on the free ends of linear DNA molecule. Therefore, instead of producing DNA fragments with sticky ends, it will shorten or completely degrade the DNA fragment containing the gene of interest, and the circular plasmid (vector) will not get cut as it lacks free ends.

70. Restriction enzymes present in the cloning site of a vector should not have more than one recognition site. Comment.

Ans. It the restriction enzymes have more than one recognition site in a vector, than the vector itself will get fragmented on treatment with the restriction enzyme.

71. What does 'competent' refer to in competent cells used in transformation?

Ans: Competent means bacterial cells, on treatment with $CaCl_2$, are made capable of taking up foreign DNA.

72. What is the significance of adding proteases at the time of isolation of genetic material (DNA).

Ans: Role of proteases is to degrade the proteins present inside a cell (from which DNA is being isolated). If the proteins are not removed from DNA preparation then they could interfere with any downstream treatment of DNA (such action of restriction endonuclease, DNA ligase etc).

73. While doing a PCR, 'denaturation' step is missed. What will be its effect on the process?

Ans: If denaturation of double-stranded DNA does not take place, then primers will not be able to anneal to the template, no extension will take place, hence no amplification will occur.

74. Name a recombinant vaccine that is currently being used in vaccination program?

Ans: Hepatitis B recombinant vaccine-engerix is used for vaccination of hepatitis-virus.

75. Expand GMO. How is it different from a hybrid?

Ans. GMO stands for Genetically Modified Organism. It differs from a hybrid because in a hybrid, cross is done between total genomes of two species or strains, where as in a GMO, foreign gene(s) is introduced in the organism, and is usually maintained as extra-chromosomal entity or is integrated into the genome of the organism.

76. Differentiate between diagnostics and therapeutics. Give one example under each category.

Ans. A diagnostic technique helps us to identify a disease. Example: ELISA to test for HIV. A therapeutic agent on the other hand helps in the treatment of a disease. Example: Antibiotics for bacterial infections.

77. Many proteins are secreted in their inactive form. This is also true of many toxic proteins produced by micro organisms. Explain how the mechanism is useful for the organism producing the toxin?

Ans. Many proteins including certain toxins are secreted in their inactive form. They get activated, only when exposed to a specific trigger (pH. temperature etc.). It is advantageous to the bacteria producing it because the bacteria does not get killed due to the action of protein.

78. Name the first transgenic cow. Which gene was introduced in this cow?

Ans. Rosie was the name of the first transgenic cow. Gene for human alpha lactalbumin was introduced in its gene, which made the milk nutritionally richer.

79. PCR is a useful tool for early diagnosis of an infectious disease. Comment.

Ans. PCR is a very sensitive technique which enables the specific amplification of desired DNA from a limited amount of DNA template. Hence, it can detect the presence of an infectious organism in the infected patient at an early stage of infection (even before the infectious organism has multiplied to large number).

80. What is GEAC and what are its objectives?

Ans. GEAC (Genetic Energy Approval Committee) is an Indian government organisation. Its objective are to:

a. examine the validity of GM (Genetic modification of organism) research.

b. inspect the safety of introducing GM for public services.

81. For which variety of Indian rice, patent was filed by a USA Company?

Ans. Indian Basmati was crossed with semi-dwarf variety and was claimed as a new variety for which the patent was filed by a USA company.

82. Species that tolerate narrow range temperature are called _____.

Ans. (Stenothermic)

83. What are Eutythermic species?

Ans. Species that tolerate wide range of temperature are called Eurythermic species.

84. Species that tolerate wide range of salinity are called _____

Ans. (Euryhaline)

85. What is Mycorrhiza?

Ans. Mycorhiza is a symbiotic association between a fungus and the roots of higher plants.

86. What would be the growth pattern, when the resources are unlimited.

Ans. Exponential.

87. Give a suitable example for commensalism.

Ans. Cattle egret and grazing cattle.

88. Name an organism found as secondary carnivore in an aquatic ecosystem in your area.

Ans. Catfish / water snake etc.

89. What does the base tier of the ecological pyramid represent?

Ans. Producers

90. Under what conditions would a particular stage in the process of succession revert back to an earlier stage?

Ans. Natural or human induced disturbances like fire, deforestation etc.

91. Arrange the following as you observe in vertical stratification of a forest- Grass, Shrubby plants, Teak, Amaranths.

Ans. Grass, Amaranths, Shrubby plants, Teak

92. Name an omnivore which occurs in both grazing food chain and the decomposer food chain.

Ans. Sparrow / crow

93. Justify the pitcher plant as a producer.

Ans. It is chlorophyllous and is thus capable of photosynthesis.

94. Name any two organisms which occupy more than one trophic level in an ecosystem.

Ans. Man and sparrow etc.

95. Climax stage is achieved quickly in secondary succession as compared to primary succession. Why?

Ans. The rate of succession is much faster in secondary succession as the substratum (soil) is already present as compared to primary succession where the process starts from a bare area (rock).

96. Among the crustose, foliose and fruticose lichens which one is a pioneer species?

Ans. Crustose lichens.

97. Why is the rate of assimilation of energy at the herbivore level called secondary productivity?

Ans. It is because the biomass available to the consumer for consumption is a resultant of the primary productivity from plants.

98. What is common to earthworm, mushroom, soil mites and dung beetle in an ecosystem.

Ans. They are all detritivores i.e., decomposing organisms which feed on dead remains of plants and animals.

99. According to David Tilman greater the diversity greater is the primary productivity. Can you think of a very low diversity man-made ecosystem that has high productivity.

Ans. Agricultural fields like wheat field / paddy field which are also examples of monoculture practices.

100. What is the difference between endemic and exotic species?

Ans . Endemic species are restricted native to a particular geographical region. Exotic species are species which are introduced from other geographical regions into an area.

101. Why is genetic variation important in the plant *Rauwolfia vomitoria*?

Ans . Genetic variation affects the production of the drug principle reserpine in the medicinal plant *Rauwolfia*.

102. What is the Red Data Book?

Ans. The Red data book is a compilation of data on species threatened with extinction, maintained by IUCN.

103. What is the expanded form of IUCN?

Ans. International Union for Conservation of Nature and Natural Resources.

104. What is common to both the species shown in figures A and B?

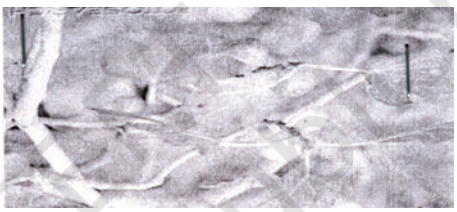
A

B

Ans. Both are invasive weed species

105. What is common to the species shown in figures A and B?

A



B

Ans. Both are examples for Keystone species

106. In which year was the Air (Prevention and control of pollution) Act amended to include noise as air pollution.

Ans. 1987.

107. Name the city in which the entire public road transport runs on CNG.

Ans. Delhi.

108. It is a common practice to undertake desilting of the overhead water tanks. What is the possible source of silt that gets deposited in the water tanks.

Ans. The soil particles carried by water from the source of supply.

109. What is the raw material for polyblend?

Ans. Plastic waste.

110. Name an industry which can cause air pollution, thermal pollution and eutrophication.

Ans. Fertiliser factory.

ANSWERS TO SA TYPE QUESTIONS

1. In haploid organisms that undergo sexual reproduction, name the stage in the life cycle when meiosis occurs. Give reasons for your answer.

Ans. Meiosis takes place duxing is post-zygotic stage. Since the organism is hapoid, meiosis cannot occur during gametogenesis.

2. The number of taxa exhibiting asexual reproduction is drastically reduced in the higher plants (angiosperms) and higher animals (vertebrates) as compared with lower groups of plants and animals. Analyse the possible reasons for this situation.

Ans. Both angiosperms and vertebrates have a more complex structural organisation. They have evolved very efficient mechanism of sexual reproduction. Since asexual reproduction does not create new genetic pools in the offspring and consequently hampers their adapability to external conditions, these groups have resorted to reproduction by the sexual method.

3. With which type of reproduction do we associate the reduction division? Analyse the reasons for it.

Ans. Reduction division (meiosis) is associated with sexual reproduction. The reasons for this are:

a. Since sexual reproduction involves the fusion of two types of gametes (male and female), they must have haploid number of chromosomes.

b. The cell (meiocyte) which gives rise to gametes often has diploid number of chromosomes and it is only by reducing the number by half that we can get haploid gametes.

c. Reduction division also ensures maintenance of constancy of chromosome number from generation to generation.

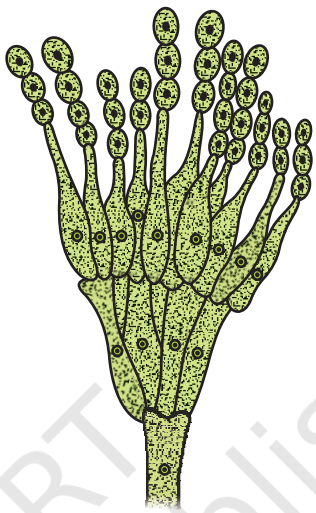
4. 'Fertilisation is not an obligatory event for fruit production in certain plants'. Explain the statement.

Ans. Yes, it is observed in parthenocarpic fruits. The 'seedless fruits' that are available in the market such as pomegranate, grapes etc., are infact good examples. Flowers of these plants are sprayed by a growth hormone that induces fruit development even though fertilisation has not occurred. The ovules of such fruits, however, fail to develop into seeds.

5. Draw the sketches of a zoospore and conidium. Mention two dissimilarities between them and atleast one feature common to both structures.

Ans.

Zoospore



Conidiumphore

Dissimilarities

Zoospore	**Conidium**
1. Flagellated	1. Non-flagellated
2. Formed inside a sporongium (endogenously)	2. Formed at the tip of conidiophores (exogenously)

The common feature is that both are asexual reproductive structures.

6. Given below are the events that are observed in an artificial hybridization programme. Arrange them in the correct sequential order in which they are followed in the hybridization programme.

(a) re-bagging; (b) selection of parents; (c) bagging; (d) dusting the pollen on stigma; (e) emasculation; (f) collection of pollen from male parent.

Ans. b; e; c; f; d and a.

7. Why does the zygote begin to divide only after the division of primary endosperm cell?

Ans. The zygote needs nourishment during its development. As the mature, fertilised embryo sac offers very little nourishment to the zygote, the PEC divides and generates the endosperm tissue which nourishes the zygote. Hence, the zygote always divides after division of PEC.

8. The generative cell of a 2-celled pollen divides in the pollen tube but not in a 3-celled pollen. Give reasons.

Ans. In a 3-celled pollen, the generative cell has already divided and formed 2 male gametes. Hence, it will not divide again in the pollen tube. Since in a 2-celled pollen, the generative cell has not divided, it divides in the pollen tube.

9. Women experiences two major events in their life time one at menarche and the second at menopause, mention the characteristics of both the events.

Ans. Menarche represents the beginning of menstrual cycle which is an indication of attainment of sexual maturity. Menopause, on the other hand, refers to the cessation of menstruation which inturn means stoppage of gamete production i.e., it marks the end of reproductive/ fertile life of the female.

9. Corpus luteum in pregnancy has a long life. However, if fertilisation does not take place it remains active only for 10-12 days . Why?

Ans. This is because of a neural signal given by the maternal endometrium to its hypothalamus in presence of a zygote to sustain the gonadotropin (LH) secretion, so as to maintain the corpus luteum as long as the embryo remains there. In the absence of a zygote, therefore, the corpus luteum can not be maintained longer.

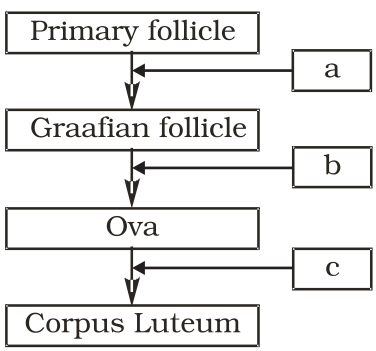
10. Placenta has endocrine function. Does it have other functions? Explain.

Ans. Placenta facilitates the supply of oxygen and nutrients to the embryo. It also removes CO_2 excretory wastes produced by embryo.

11. What are the events taking place in the ovary and uterus during follicular phase of the menstrual cycle.

Ans.
1. The primary follicle grow and become fully mature graafian follicles.
2. Secretion of estrogen hormone.
3. Endometrium of uterus regenerates through proliferation.

12. Given below is a flow chart showing ovarian changes during menstrual cycle. Fill in the spaces with the hormonal factor/s responsible for the events shown.



Ans. a – FSH and estrogen; b-LH; C-progesterone

14. In GIFT, gametes are transferred to the fallopian tube. Can gametes be transferred to the uterus to achieve the same result? Explain.

Ans. The uterine environment is not congenial for the survival of the gamete. If, directly transferred to the uterus they will undergo degeneration or could be phagocytosed and hence viable zygote would not be formed.

15. Briefly explain IVF and ET. What are the conditions in which these methods are advised?

Ans. IVF and ET refers to In vitro Fertilisation and Embryo Transfer. Gametes from the male and female are collected hygienically and induced to fuse in the laboratory set up under simulated conditions. The zygote formed is collected and is introduced into the uterine region of a host or surrogate mother at an appropriate time (secretory phase). Early embryos (upto 8 cell) are generally transferred to the fallopian tube whereas embryos with more than 8 cells are transferred to the uterns.

16. All reproductive tract infections (RTIs) are STDs, but all STDs are not RTIs- Justify with example.

Ans. Among the common STs-gonorrhea, syphilis, genital herpes, chlamydiasis, hepatitis-B, AIDs etc., hepatitis-B, and AIDs are not infections of the reproductive organs though their mode of transmission could be through sexual contact also. All other diseases are transmitted through sexual contact and are also infections of the reproductive tract.

17. In a mendelian monohybrid cross the F_2 generation shows identical genotypic and phenotypic ratios. What does it tell us about the nature of alleles involved? Justify your answer.

Ans. In a monohybrid cross, starting with parents which homozygous dominant and homozygous recessive, F1 would be heterozygous for the trait and would express the dominant allele. But in case of incomplete dominance, a monohybrid cross shows the result as follows.

F_1 R R (Red) X r r (White)

↓

R r

all pink

R R (Red) X r r (White)

↓

F_2 R R (Red) rR rR rr

Prime : Prime : White

1 : 2 : 3

Phenotypic ratio

Genotypic ratio

Here the genotypic and phenotypic ratios are the same. So, we can conclude that when genotypic and phenotypic ratios are the same, the alleles show incomplete dominance.

18. What is Down's syndrome? Give its symptoms and cause. Why is it that the chances of having a child with Down's syndrome increases if the age of the mother exceeds forty years?

Ans. Down's syndrome is a human genetic disorder caused due to trisomy of chromosome no. 21. Such individuals are aneuploid and have 47 chromosomes. (2n + 1) The symptoms include mental retardation, growth abnormalities, constantly open mouth, dwarfness etc. The reason for the disorder is the non-disjunction (failure to separate) of homologous chromosome of pair 21 during meiotic division in the ovum. The chances of having a child with Down's syndrome increase with the age of the mother (+ 40) because ova are present in females. since their birth and therefore older cells are more prone to chromosomal non-disjunction because of various physico-chemical exposures during the mother's life-time.

19. What are the characteristic features of a true-breeding line?

Ans. A true-breeding line for a trait is one that, has undergone continuous self-pollination or brother-sister mating, showing a stability in the inheritance of the trait for several generations.

20. In peas, tallness is dominant over dwarfness, and red colour of flowers is dominant over the white colour. When a tall plant bearing red flowers was pollinated by a dwarf plant bearing white flowers, the different phenotypic groups were obtained in the progeny in numbers mentioned against them.

Tall, Red = 138
Tall, White = 132
Dwarf, Red = 136
Dwarf, White = 128

Mention the genotypes of the two parents and of the types of four offspring.

Ans. The result shows that the four types of offspring are in a ratio of 1:1:1:1. Such a result is observed in a test-cross progeny of a dihybrid cross.

The cross can be represented as:

Tall & Red (Tt Rr) × Dwarf & white (ttrr)

offsprings		tr		
Tt Rr – Tall, Red	TR	TtRr	Tall	Red
Tt rr – Tall, White	Tr	Ttrr	Tall	White
Tt Rr – dwarf, red	tR	ttRr	dwarf	Red
tt rr – dwarf, white.	tr	ttrr	dwarf	white

21. Why is the frequency of red-green colour blindness is many times higher in males than that in the females?

Ans. For becoming colourblind, the female must have the allele for it in both her X-chromosomes; but males develop colourblindness when their sole x-chromosome has the allele for it.

22. If a father and son are both defective in red-green colour vision, is it likely that the son inherited the trait from his father? Comment.

Ans. Gene for colourblindness is X-chromosome linked, and sons receive their sole from their mother, not from their father. Male-to-male inheritances is not possible for X-linked traits in humans. In the given case the mother of the child must be a carrier. (heterozygous) for colour blindness gene.

23. Retrovirus do not follow central dogma. Comment.

Ans: Genetic material of retrovirus is RNA. At the time of synthesis of protein, RNA is 'reverse transcribed' to its complementary DNA first, which is opposite to the central dogma. Hence, retrovirus are not known to follow central dogma.

24. In an experiment, DNA is treated with a compound which tends to place itself amongst the stacks of nitrogenous base pairs. As a result of which, the distance between two consecutive base increases, from 0.34nm to 0.44 nm. Calculate the length of DNA double helix (which has 2×10^9 bp) in the presence of saturating amount of this compound.

Ans. $2\times10^9 \times 0.44 \times 10^{-9}$/bp

25. What would happen if histones were to be mutated and made rich in amino acids aspartic acid and glutamic acid in place of basic amino acids such as lysine and arginine?

Ans. If histone proteins were rich in acidic amino acids instead of basic amino acids then they may not have any role in DNA packaging in eukaryotes as DNA is also negatively charged molecule. The packaging of DNA around the nucleosome would not happen. Consequently, the chromatin fibre would not be formed.

26. Recall the experiment done by Frederick Griffith. If RNA, instead of DNA was the genetic material, would the heat killed strain of *strepts* have transformed the R-strain into virulent strain? Explain your answer.

Ans: RNA is more labile and prone to degradation (owing to the presence of 2' OH group in its ribose). Hence heat-killed S-strain may not have retained its ability to transform the R-strain into virulent form if RNA was its genetic material.

27. You are repeating the Hershey-Chase experiment and are provided with two isotopes: ^{32}P and ^{15}N (in place of ^{35}S in the original experiment). How do you expect your results to be different?

Ans. Use of ^{15}N will be inappropriate because method of detection of ^{35}p and ^{15}N is different (^{32}p being a radioactive isotope while ^{15}N is not radioactive but is the heavier isotope of Nitrogen). Even if ^{15}N was radioactive then its presence would have been detected both inside the cell (^{15}N incorporated as nitrogenous base in DNA) as well as in the supernatant because ^{15}N would also get incorporated in amino group of amino acids in proteins). Hence the use of ^{15}N would not give any conclusive results.

28. There is only one possible sequence of amino acids when deduced form a given nucleotides. But multiple nucleotide sequences can be deduced from a single amino acid sequence. Explain this phenomena.

Ans. Some amino acids are coded by more than one codon (known as degeneracy of codons), hence on deducing a nucleotide sequence from an amino acid sequence, multiple nucleotide sequence will be obtained.

For e.g., Ile has three codous: AUU, AUC AUA hence a depeptide Met–Ile can have the following nucleotide sequence:

(i) AUG – AUU
(ii) AUG – AUC
(iii) AUG – AUA

and if, we deduce amino acid sequence the above nucleotide sequences, all the three will code for Met–Ile

29. A single base mutation in a gene may not 'always' result in loss or gain of function. Do you think the statement is correct? Defend your answer.

Ans. The statement is correct. Because of degeneracy of codons, mutations at third base of codon, usually does not result into any change in phenotype. This is called silent mutations.

30. A low level of expression of lac operon occurs at all the time. Can you explain the logic behind this phenomena.

Ans: In the complete absence of expression of lac operon, permease will not be synthesised which is essential for transport of lactose from medium into the cells. And if lactose cannot be transported into the cell, then it cannot act as inducers hence, cannot relieve the lac operon from its repressed state.

31. Would it be appropriate to use DNA probes such as VNTR in DNA fingerprinting of a bacteriaphage?

Ans. Bacteriaphage does not have repetitive sequences such as VNTRs in its genome as its genome is very small and have all the coding sequence. DNA finger printing is not done for phages.

32. During in vitro synthesis of DNA, a researcher used 2', 3' – dideoxy cytidine triphosphate as raw nucleotide in place of 2'-deoxy cytidine triphosphate other conditions remaining as standard. Will further polymerisation of DNA continue upto the end or not? Explain.

Ans. Further polymerisation would not occur, as the 3' OH on sugar is not there to add a new nucleotide for forming ester bond.

33. What background information did Watson and Crick had available with them for developing a model of DNA? What was their own contribution?

Ans. Wastson and Crick had the following informations which helped them to develop a model of DNA.

(i) Chargaffs' Law suggesting A = T, and C = G.

(ii) Wilkins and Rosalind Franklin's work on DNA crystal's X-ray diffraction studies about DNA's physical structure.

(iii) Watson and crick proposed

a. How complementary bases may pair

b. Semi conservative replication and

c. Mutation through tautomerism.

34. What are the functions of (i) methylated guanasine cap, (ii) poly-A "tail" in a mature on RNA?

Ans. Methylated Guanine cap helps in binding of mRNA to smaller ribosomal sub-unit during initiation of translation. Poly– A tail provides longevity to mRNA's life. Tail length and longevity of mRNA are positively correlated.

35. Do you think that the alternate splicing of exons may enable a structural gene to code for several isoproteins from one and the same gene? If yes, how? If not, why so?

Ans. Functional mRNA of structural genes need not always include all of its exons. This alternate splicing of exons is sex-specific, tissue-specific, and even developmental stage-specific. By such alternate splicing of exons, a single gene may encode for several isoproteins and/or proteins of similar class. In absence of such a kind of splicing, there should have been new genes for every protein/isoprotein. Such an extravagancy has been avoided in natural phenomena by way of altemate splicing.

36. Comment on the utility of variability in number of tandem repeats during DNA finger printing.

Ans. Tandemness in repeats provides many copies of the sequence for finger-printing, and variability in nitrogen base sequence in them. Being individual-specific, this proves to be useful in the process of DNA fingerprinting.

37. Scientists claim that nascent oxygen is toxic to aerobic life forms. What are the reasons.

Ans. Nascent oxygen is highly reactive. It can react readily with different kinds of molecules, including DNA, proteins present in the cells of aerobic life forms. This may lead to mutations and undesirable metabolic changes.

38. While creation and presence of variation is directionless, natural selection is directional as it is in the context of adaptation. Comment.

Ans. Creation and variation occur in a sexually reproducing population as a result of crossing over during meiosis and random fusion of gametes. It is however the organisms that are selected over a period of time which are determined by the environmental conditions. In other words, the environment provides the direction with respect to adaptations so that the organisms are more and more fit in terms of survival.

39. Gene flow occurs through generations. and can occur across language barriers in humans. If we have a technique of measuring specific allele frequencies in different population of the world, can we not predict human migratory patterns in pre-history and history? Do you agree or disagree? Provide explanation to your answer.

Ans. Yes, I agree. Gene flow occurs through generations. By studying specific allele frequencies, we can predict the human migratory patterns in pre-history and history. Studies have used specific genes/chromosomes/ mitochondrial DNA to trace the evolutionary history and migratory patterns of humans. (The project is known as the Human Genographics Project).

40. When we say "survival of the fittest", does it mean that

a. Those which are fit only survive, or

b. Those that survive are called fit

Comment.

Ans. Those individuals which survive and reproduce in their respective environment are called fit.

41. Enumerate three most characteristic criteria for designating a Mendelian population.

Ans. Population must be sufficiently large with potentialities for free flow of genetic material among individuals (through sexual reproduction). Migration should either be nil or negligible.

42. "Migration may enhance or blurr the effects of selection". Comment.

Ans. Migration may cause enrichment of the gene pool of such alleles that are being selected for, or anull the effects of selection through replishment of alleles that were selected against by nature.

43. From which plant are Cannabinoids obtained? Name any two Cannabinoids. Which part of the body is effected by consuming these substances?

Ans. Cannabinoids are obtained from the inflorescence of the plant *Cannabis sativa*. Marijuana, hashish, charas, ganja are some Cannabinoids. These chemicals interact with Cannabinoid receptors of the body, mainly present in the brain. Cardiovascular system is effected adversely.

44. In the metropolitan cities of India, many children are suffering from allergy/asthma. What are the main causes of this problem. Give some symptoms of allergic reactions.

Ans. Allergy is the exaggerated response of the immune system of certain antigens present in the environment. In metropolitan cities life style is responsible in lowering of immunity and sensitivity to allergens. More polluted environment increases the chances of allergy in children.
Some symptoms of allergic reactions are sneezing, watery eyes, running nose and difficulty in breathing.

45. What is the basic principle of vaccination? How do vaccines prevent microbial infections? Name the organism from which hepatitis B vaccine is produced.

Ans. The principle of vaccination is based on the property of `memory' of the immune system. In vaccination, a preparation of antigenic proteins of pathogens or inactivated/live but weakened pathogens is introduced into the body. The antigens generate the primary immune response by producing antibodies. The vaccines also generate the memory B-cells and T-cells. When the vaccinated person is attacked by the same pathogens, the existing memory B-cells or T-cells recognises the antigen quickly and overwhelm the invaders with massive production of lymphocytes and antibodies. Hepatitis B vaccine is produced from yeast.

46. What is Cancer? How is a Cancer cell different from normal cell? How do normal cells attain Cancerous nature?

Ans. An abnormal and uncontrolled division of cells is termed as Cancer.

The Cancerous cells are different from the normal cells in the following ways.

Cancer Cells	**Normal Cells**
1. Cancer cells divide in an uncontrolled manner.	1. Normal cells divide in a controlled manner.
2. The cells do not show contact inhibition	2. The cells show contact inhibition.
3. Life span is indefinite	3. Life span is definite.

In our body, the growth and differentiation of cells is highly controlled and regulated. The normal cells show a property called contact inhibition.

The surrounding cells inhibits uncontrolled growth and division of cells. The normal cells lose this property and become cancerous cells giving rise to masses of cells called tumors. Transformation of normal cells into cancerous cells is induced by some physical, chemical and biological agents (carcinogens).

47. A person shows strong unusual hypersensitive reactions when exposed to certain substances present in the air. Identify the condition. Name the cells responsible for such reactions. What precaution should be taken to avoid such reactions.

Ans. Allergy. Mast Cells are responsible for such reactions.

To avoid such reactions following precautions must be taken.

(i) The use of drugs like antihistamine, adrenalin and steroids quickly reduce the symptoms of allergy.

(ii) Avoid contact with substances to which a person is hypersensitive.

48. Life style diseases are increasing alarmingly in India. We are also dealing with large scale malnutrition in the population. Is there any method by which we can address both these problems?

Ans. The answer to address both these problems is called biofortification. This area looks at improving food quality with respect to protein, oil, vitamin, micro nutrient and mineral content. The oils need to be rich in omega 3 fatty acids which are good for heart. Similarly, proteins should have more of lysine and tryptophan (essential amino acids). Many varieties of maize, carrots and spinach have been released which fulfill the above criteria.

49. How can we improve the success rate of fertilisation during artificial insemination in animal husbandry programmes?

Ans. The technology is called MOET or Multiple Ovulation Embryo Transfer. During the procedure, a cow is given hormonal treatment so that more than one ovule (6-8 eggs) is produced per cycle. After mating or artificial insemination the embryos at 8-32 celled state are transferred to different surrogate mother cows. The method has been successfully used for cattle, sheep, buffalo etc.

50. What is meant by germplasm collection? What are its benefits?

Ans. The collection of all the diverse alleles of all the genes of a crop plant is called germplasm collection. It is of great benefits in plant breeding programmes as it offers, to the breeders, the entire of genes and alleles and the characteristics which they express. The breeder selects the most favourable characters of a particular gene and manipulates its transfer to a desirable parent.

51. Name the three improved characteristics of wheat that helped India achieve green revolution.

Ans.
i. Semi-dwarf nature
ii. Quick yielding feature
iii. High yielding feature
iv. Disease resistant feature

52. Suggest two features of plants that will prevent insect and pest infestation

Ans.
i. increasing hair growth on aerial parts of plants.
ii. Rendering the flowers nectar less.
iii. Enabling plants to secrete insect killing chemicals (toxins)

53. What are the physical barriers of a cell in the protoplast fusion experiment? How are the barriers overcome?

Ans. Cell wall is the most important physical barrier in such experiments. This can be overcome by treatment with enzymes like cellulose and pectinase which have the ability to digest the cell wall and liberate the naked protoplast surrounded only by the cell membrane.

54. Give two examples of biofortified crops. What benefits do they offer to the society?

Ans. Maize, wheat, rice, bathua, spinach, pulses have biofortified varieties.

Maize hybrids have twice the amount of amino acids, fortified wheat variety has high protein content, fortified rice has high quantity of iron. Consumption of such biofortified foods will enrich the nutritive value of our common foods and will vastly improve public health. Instead of consuming different food items for obtaining different nutrients, if 2 or 3 nutrients can be incorporated into a single crop, it offers enormous benefits to human beings and may even help cover come several nutrient deficiency disorders latent in our country.

55. How has the bacterium *Bacillus thuringiensis* helped us in controlling caterpillars of insect pests?

Ans. *Bacillus thuringiensis* products are endotoxin which when ingested and released in the gut of the larvae of insect pest disrupts the insect gut lining thereby killing them.

56. How do mycorrhizal fungi help the plants harbouring them?

Ans. The mycorrhizal fungi absorb phosphorus from the soil and transfer them to the host cells. They also impart resistance to host plants against root pathogens. They also help plant tolerate salinity and draught.

57. How was penicillin discovered?

Ans. Penicillin was an accidental discovery. Sir Alexander Fleming observed that in unwashed culture plates of *Staphylococcus*, a mould *Penicillium* was growing This mould inhibited the growth of *Staphylococcus* . Latre the antibitic *Penicillin* was isolated from this fungus.

58. What is the chemical nature of biogas. Name an organism which is know to be employed in biogas?

Ans. The chemical nature of Biogas is methane, CO_2 & H_2. *Methanobacteria*, a type of methonogen is employed for biogas production.

59. What is a broad spectrum antibiotic? Name a broad spectrum antibiotic and source organism.

Ans. A broad spectrum antibiotic is one which can inhibit the growth of both G +ve & G -ve bacteria.

60. What do you understand by gene cloning?

Ans. Gene cloning refers to a process in which a gene of interest is ligated to a vector. The recombinant DNA thus produced is introduced in a host cell by transformation. Each cell gets one DNA molecule and when the transformed cell grows to a bacterial colony, each cell in the colony has a copy of the gene. This is precisely gene cloning.

61. A wine maker and a molecular biologist who has developed a recombinant vaccine, both claim themselves to be biotechnologist. Who in your opinion is right?

Ans. Both. As biotechnology is a very wide area which deals with techniques of using a 'natural' organism (or its parts) as well as genetically modified organism to produce products and processes useful for mankind. A wine maker employs a strain of yeast to produce wine by fermentation (a natural phenomenon), while the molecular biologist has cloned gene for the antigen (that is used as vaccine) in an organism which allows the production of the antigen in large amount.

62. You have created a recombinant DNA molecule by ligating a gene to a plasmid vector. By mistake, your friend adds exonuclease enzyme to the tube containing the recombinant DNA. How will your experiment get affected as you plan to go for transformation now?

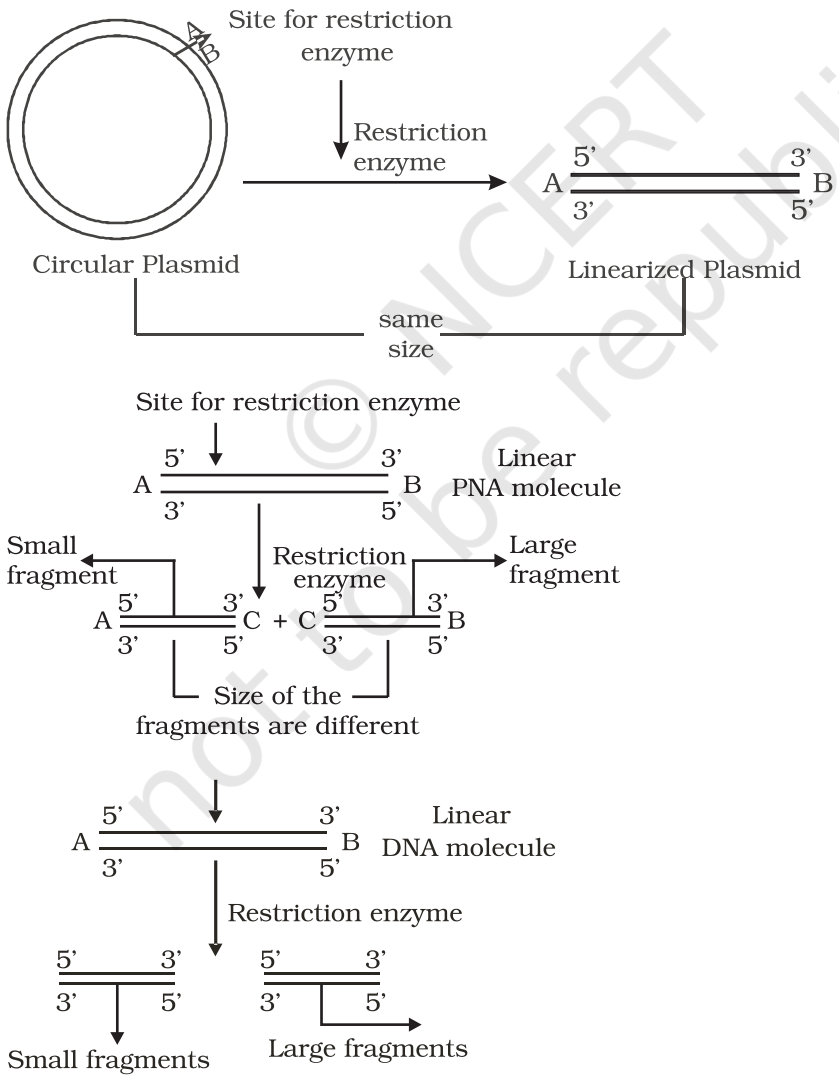
Ans: The experiment will not likely to be affected as recombinant DNA molecule is circular closed, with no free ends. Hence, it will not be a substrate for exonuclease enzyme which removes nucleotides from the free ends of DNA.

63. The restriction enzymes that are used in construction of recombinant DNA molecule are endonucleases which cut the DNA at 'specific-recognition sequence'. What would be the disadvantage if they would not cut the DNA at specific-recognition sequence?

Ans: If the restriction enzymes would cut DNA at random sites instead of at specific sites, then the DNA fragments obtained will not have 'sticky ends'. In the absence of sticky ends, construction of recombinant DNA molecule would not be possible.

64. A plasmid DNA and a linear DNA (both of the same size) have one site for a restriction endonuclease. When cut and separated on agarose gel electrophoresis, plasmid shows one DNA band while linear DNA shows two fragments. Explain.

Ans: It is because plasmid is a circular DNA molecule. When cut with enzyme, it becomes linear but does not get fragmented. Whereas, a linear DNA molecule gets cut into two fragment. Hence, a single DNA band is observed for plasmid while two DNA bands are observed for linear DNA in agarose gel.



65. How do you visualise DNA on an agarose gel?

Ans: A compound called Ethidium Bromide stains DNA, which on irradiating with Ultra Violet, fluoresce gives orange light. Hence, DNA fragments appear as orange band in the presence of Ethidium B romide and UV.

66. You have chosen a plasmid as vector for cloning your gene. However this vector plasmid lacks a selectable marker. How would it affect your experiment?

Ans: In a gene cloning experiment, first a recombinant DNA molecule is constructed, where the gene of interest is ligated to the vector, [The step would not be affected] and introduced inside the host cell (transformation). Since, not all the cells get transformed with the recombinant / plasmid DNA, in the absence of selectable marker, it will be difficult to distinguish between transformants and non-transformant, because role of selectable marker is in the selection of transformants.

67. A mixture of fragmented DNA was electrophoresed in agarose gel. After staining the gel with ethidium bromide, no DNA bands were observed. What could be the reason?

Ans. The reasons are as follows:

(i) DNA sample that was loaded on the gel may have got contaminated with nuclease (exo-or endo-or both) and completely degraded.

(ii) Electrodes were put in opposite orientation in the gel assembly that is anode towards the wells (where DNA sample is loaded). Since DNA molecules are negatively charged, they move towards anode and hence move out of the gel instead of moving into the matrix of gel.

iii) Ethidium bromide was not added at all or was not added in sufficient concentration and so DNA was not visible.

68. Describe the role of $CaCl_2$ in preparation of competent cells?

Ans. $CaCl_2$ is known to increase the efficiency of DNA uptake to produce transformed bactrial cells. The divalent Ca^{+2} ions supposedly create transient pores on the bactrial cell wall by which the entry of foreign DNA is facilitated into the bactrial cells.

69. What would happen when you grow a recombinant in a bioreactor but forget to add antibiotic to the medium in which the recombinant is growing.

Ans. In the absence of antibiotic, there will be no pressure on recombinants to retain the plasmid (containing the gene of your interest). Since, maintaining a high copy number of plasmids is a metabolic burden to the microbial cells, will thus tend to lose the plasmid.

70. Gene expression can be controlled with the help of RNA molecule. Explain the method with an example.

Ans. Gene expression can be controlled by using RNA molecule. The technology is called RNA interference or RNAi. It is used to block the expression of certain genes and also referred to as gene silencing. During this process a complementary RNA to the mRNA being produced by the gene is introduced into the cell. This RNA binds to the mRNA making it double stranded and therefore stops translation. Resistance to nematode *Meloidegyne incognita* in tomato has been achieved by this method.

71. Define the terms Antigen and Antibody. Name any two diagnostic kits based upon them.

Ans. An antigen is a foreign substance that elicits the formation of an antibody. Antibody is a protein that is synthesised in response to an antigen. Antigen and antibody show high degree of specificity in binding each other Two diagnostic kits based on antigen-antibody interaction are.

a. ELISA for HIV.

b. Pregnancy test kits.

72. ELISA technique is based on the principles of antigen and antibody interaction. Can this techique be used in *the molecular* diagnosis of a genetic disorder, such as phenyketonuria?

Ans. Yes. One can use antibody against the enzyme (that is responsible for the metabolism of phenylalanine) to develop ELISA based diagnostic technique. The patient where the enzyme protein is absent would give negative result in ELISA when compared to normal individual.

73. How is a mature, functional insulin hormone different from its pro-hormone form?

Ans. Mature functional insulin is obtained by processing of pro-hormone which contains extra peptide called C-peptide. This C-peptide is removed during maturation of pro-insulin to insulin.

74. Gene therapy is an attempt to correct a genetic defect by providing a normal gene into the individual. By this the normal function can be restored. Alternate method would be to provide the gene product (protein/ enzyme) know as enzyme replacement therapy, which would also restore the function. Which in your opinion is a better option? Give reason for your answer.

Ans. Gene therapy would be a better option because it has the potential to completely cure the patient. It is because the correct gene once introduced in the patient, can continue to produce the correct protein enzyme. Enzyme therapy does not offer permanent cure as it needs to be given to the patient on regular basis. It is also more expensive.

75. Transgenic animals are the animals in which a foreign gene is expressed. Such animals can be used to study the fundamental biological process/ phenomenon as well as for producing products useful for mankind. Give one example for each type.

Ans. Study basic biological process- how gene are regulated, how they affect the normal functions of the body and its development. Transgenic cow, Rosie is the example for the second category.

76. When a foreign DNA is introduced in to an organism, how it is maintained in the host and how it is transferred to the progeny of the organism?

Ans. Foreign gene is usually ligated to a plasmid vector and introduced in the host. As plasmid replicates, and makes multiple copies of itself, so does the foreign gene gets replicated and its copes are made. When the host organism divides, its progeny also receives the plasmid DNA containing the foreign gene.

77. Bt cotton is resistant to pest, such as lepidopteron, dipterans and coleopterans. Is Bt cotton resistant to other pests as well?

Ans. Bt cotton is made resistant to only certain specific taxa of pests. It is quite likely that in future, some other pests may infest this Bt cotton plants. It is similar immunisation against small-pox which does not provide immunity against other pathogens like those that cause cholera, typhoid etc.

78. Why are coral reefs not found from West Bengal to Andhra Pradesh but found in Tamil Nadu on the east coast of India?

Ans. High salinity, optimal temperature and less siltation are essential to colonise corals. If siltation and fresh water inflow are very high, the corals don't colonise. In contrast when the siltation and fresh water inflow by the rivers are very less, the coral do colonise.

79. In a sea shore, the benthic animals live in sandy, muddy and rocky substrata and accordingly developed the following adaptations. Find the suitable substratum against each adaptation.

a. Burrowing _____
b. Building cubes _____
c. Holdfasts / peduncle _____

Ans a. Sandy, b. Muddy, c. Rocky

80. Plants living in the water are called hydrophytes, Those living in the areas with water scarcity are called xerophytes; and the plants living in saline waters are called halophytes. Write the type of plant against the following examples.

a. *Salvinia* _____

b. *Opuntia* _____
c. *Rhizophora* _____
d. *Mangifera* _____

Ans. a. Hydrophyte, b. Xerophyte, c. Halophyte, d. Mesophyte

81. In a pond, we see plants which are free-floating; rooted–submerged; rooted emergent; rooted with floating leaves; Write the type of plant against the following examples.

a. *Hydrilla* _____
b. *Typha* _____
c. *Nymphaea* _____
d. *Lemna* _____
e. *Vallisnaria* _____

Ans. a. submerged, b. Rooted emergent, c. Rooted with floating leaves, d. free – floating, e. Rooted Submerged

82. Number of individuals of a population in a habitat per unit area is called density and density is measured in different units. Write the unit of measurement against the following:

a. Bacteria
b. Grass
c. Banyan
d. Deer
e. Fish

Ans. a. Nos. / Vol; b. Coverage / area; c. Biomass / area; d. Nos. / area; e. Wt. / area

83. What is a tree line?

Ans. When we go up the altitude, beyond a particular height no trees are found and the vegetation comprises only of shrubs and herbs. The altitude beyond which no tree is seen is known as tree line.

84. Is it Possible to achieve 'zero population growth rate? If yes, what kind of age pyramid is obtained?

Ans. Yes. An inverted bell shaped age pyramid is obtained. The young of pre reproductive age group individuals are less in number and both pre- reproductive and reproductive stages are in the same level.

85. The number of trophic levels in an ecosystem are limited. Comment.

Ans. In a food chain, only 10% of the total amount of energy is passed on to the next trophic level from the previous trophic level. So, there is a decrease in the amount of energy available at the successive trophic levels. As we

move higher up in the food chain the amount of energy diminishes to a level at which it cannot sustain any trophic level, thereby limiting the number of trophic levels.

86. What could be the reason for the fast rate of decomposition in the tropics?

Ans. The rate of decomposition is regulated by climatic factors like temperature and soil moisture as they have an effect on the activities of soil microbes. The tropics with its hot and humid climatic condition provides an environment which is ideal for the microbes to speed up the process of decomposition.

87. Flow of energy through various trophic levels in an ecosystem is unidirectional and non cyclic. Explain.

Ans. The energy from the sun reaches the food chain through the primary producers (plants). This energy is passed on through successive trophic levels in the food chain. The energy transfer in the food chain follows the 10 percent law where in only 10% of the energy is transferred from one trophic level to the next successively. So, the movement of energy is only in one direction from lower to higher trophic level.

88. Apart from plants and animals, microbes form a permanent biotic component in an ecosystem. While plants have been referred to as autotrophs and animals as heterotrophs, what are microbes referred to as? How do these microbes fulfil their energy requirements?

Ans. Microbes are referred to as heterotrophs and saprotrophs. They fulfil their energy requirement by feeding on dead remains of plants and animals through the process of decomsposition.

89. Primary productivity varies from ecosystem to ecosystem. Explain?

Ans. Primary productivity varies from ecosystem to ecosystem because it depends on the plant species inhabiting the area and their photosynthetic activity. it also depends on various environmental factors.

90. Sometimes due to biotic/abiotic factor the community remains in a particular seral stage (Pre climax) without reaching the climax. Do you agree with this statement. If, yes give a suitable example.

Ans. It is true that any change in the abiotic/biotic factor will arrest a particular seral stage leading to a pre-climax condition before the climax stage is achieved. This can happen in cases of forest fires, landslides, changes in soil characteristics, increase in herbivore population leading to overgrasing.

91. What is an incomplete ecosystem? Explain with the help of a suitable example.

Ans. An ecosystem is a functional unit with biotic and abiotic factors interacting with one another resulting in a physical structure. Absence of any component will make an ecosystem incomplete as it will hinder the functioning of the ecosystem. Exampler of such an ecosystem can be a fish tank or deep aphotic zone of the oceans where producers are absent.

92. What are the shortcomings of ecological pyramids in the study of ecosystem?

Ans. The ecological pyramid assumes a simple food chain and does not accommodate food webs. Thereby, it does not take into account the fact that species may belong to two or more trophic levels at a time. Also saprophytes despite their vital role in ecosystem are given no place in the ecological pyramids.

93. The rate of decomposition of detritus is affected by the abiotic factors like availability of oxygen, pH of the soil substratum, temperature etc. Discuss.

Ans. The decomposition of detritus is due to activities of micro organisms. The rate of growth of microbes is affected by temperature. The pH of subtratum affects the composition of microbes (acidophiles / basophiles) which degrade the dead organic matter. If oxygen is present, aerobic degradation occurs. In the absence of oxygen anaerobiosis sets in and there will be incomplete degradation. Also, the degradation is due to activity of exo enzymes secreted by the microbes and the activity of enzyme is affected by factors such as temperature etc.

94. How is the presently occurring species extinction different from the earlier mass extinctions?

Ans. Species extinction occuring at present is due to anthropogenic causes where as the earlier extinction was due to natural causes.

95. Discuss one example, based on your day-to-day observations, showing how loss of one species may lead to extinction of another.

Ans. In case a species (x) becomes extinct, the plant and animal species (M, N, O, Z) associated within an obligatory way also become extinct. For example.

(i) When a fish species which is a host for a number of parasites becomes extinct the parasite species which are uniquely dependent on the host fish will also become extinct.

(ii) The insects may be polyphagous (feed on more than one plant species) or monophagous (feed on only one particular plant species) in nature. The monophogous insect species are valuable and may become extinct if the plant species upon which it feeds becomes extinct.

96. Why are conventional methods not suitable for the assessment of biodiversity of bacteria?

Ans. Many bacteria are not culturable under normal conditions in the laboratory. This becomes a problem in studying their morphological, biochemical and other characterisations which are useful for their assessment.

97. How do scientists extrapolate the total number of species on Earth?

Ans. Scientists make a statistical comparison of the temperate-tropical species richness of an exhaustively studied group of insects and extrapolate this ratio to other groups of animals and plants to come up with a gross estimate of the total number of species on earth.

98. Is it true that there is more solar energy available in the tropics? Explain briefly.

Ans. As one moves from the equator to the polar regions, the length of the day decreases and the length of the night increases. The length of day and night are the same at the equator.

99. What is hybrid vehicle technology. Explain the advantages with a suitable example?

Ans. Vehicles running on dual mode like petrol and CNG are hybrid vehicle. As CNG is a green fuel there is conservation of fossil fuels and reduction in the environmental pollution.

100. Is it true that if the dissolved oxygen level drops to zero the water will become septic. Give an example which could lower the dissolved oxygen content of an aquatic body.

Ans. Yes, the water become septic if the dissolved oxygen drops to zero. Organic pollution (biodegradable) is an example.

101. Name any one of the green house gases and its possible source of production on a large scale. What are the harmful effects of it?

Ans. CO_2 and Methane. CO_2 levels are increasing due to burning of fossil fuels, leading to Global Warming.

102. It is a common practice to plant trees and shrubs near the boundary walls of buildings. What purpose do they serve.

Ans. The plants growing near the boundary wall act as barriers for sound pollution and act as dust catchers.

ANSWERS TO LA TYPE QUESTIONS

1. Do all the gametes formed from a parent organism have the same genetic composition? Are the DNA in identical copies of the parental genome? Analyse the situation with the background of gametogenesis and provide suitable explanation.

Ans. The gametes of a parent do not have the same genetic composition because they do not have identical copies of DNA. In the pachytene and diplotene stages of meiosis I, the phenomenon of crossing over and chiasma formation take place between homologous chromosomes. This shifts segments of DNA from one chromatid to another (homologous chromosomes) in a random manner resulting in several new combinations of DNA sequences. As a result, when meiotic division is completed, gametes possess DNA with varying degree of variations.

2. Although sexual reproduction is a long drawn, energy-intensive complex form of reproduction, many groups of organisms in Kingdom Animalia and Plantae prefer this mode of reproduction. Give atleast three reasons for this.

Ans.
a. Sexual reproduction brings about variation in the offspring.
b. Since gamete formation is proceded by meiosis, genetic recombination occurring during crossing over (meiosis-I), leads to a great deal of variation in the DNA of gametes.
c. The organism has better chances survival in a changing environment.

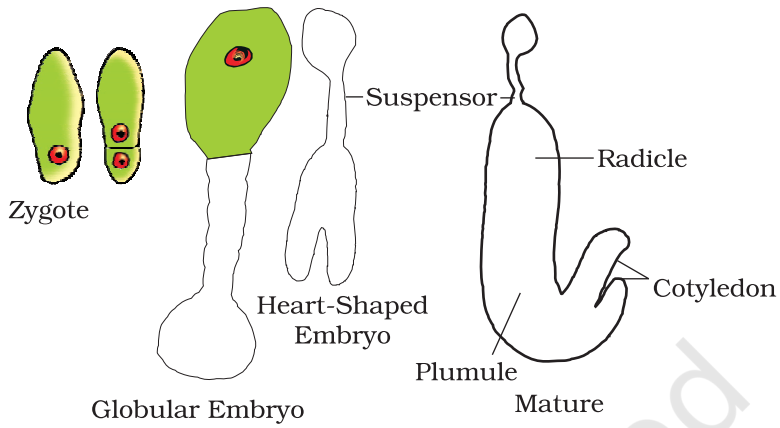
3. Rose plants produce large, attractive bisexual flowers but they seldom produce fruits. On the other hand Lady's finger produces plenty of fruits. Analyse the reasons for failure of fruit formation in rose.

Ans. Failure of fruit formation in rose may be due to several reasons. Some of the likely reasons are:

a. Rose plants may not produce viable pollen.
b. Rose plants may not have functional egg.
c. Rose plants may have abortive ovules.
d. Being hybrids, the meiotic process may be abnormal resulting in non-viable gametes.
e. There may be self-incompatibility.
f. There may be internal barriers for pollen tube growth and/or fertilisation.

4. Starting with the zygote, draw the diagrams of the different stages of embryo development in a dicot.

Ans.



5. Embryo sacs of some apomictic species appear normal but contain diploid cells. Suggest a suitable explanation for the condition.

Ans. It is true that many apomicts posses normal looking embryo sacs. The only possibility of the embryo sac possessing diploid cells is due to failure of meiotic division at the megaspore mother cell stage. Since, the megaspore mother cell has a dipoid nucleus, if it undergoes mitosis instead of meiosis, all the resulting nuclei and cells will be diploid in nature.

6. What role does pituitary gonadotrophins play during follicular and ovulatory phases of menstrual cycle and also explain the shift in steroidal secretions.

Ans. Menstrual cycle is regulated by hypothalamus through the pituitary gland. At the end of menstrual phase, the pituitary FSH gradually increases resulting in follicular development within the ovaries. As the follicles mature, Estrogen secretion increases resulting in a surge in (FSHe and LH) The surge of LH15 responsible for ovulation. LH also gonadotropins induces luteinisation. This leading to the formation of corpus luteum. Corpus luteum secretes progesterone and source estrogen which help in maintaining the interine endometrium for implantation.

7. Meiotic division during oogenesis is different from that in spermatogenesis. Explain how and why?

Ans. Unequal cytoplasmic diversion of the oocyte is to ensure the retention of bulk of cytoplasm in one cell, instead of sharing it with two. It has to provide nourishment for the developing embryo during early stages, so it is essential to retain as much cytoplasmic materials it could in a single daughter cell.

8. Enumerate and describe any five reasons for introducing sex-education to school-going children.

Ans. Proper information about reproductive organs-physiology and its functioning; discourage myths and misconceptions about sex-related aspects; knowledge about safe and hygienic sexual practices; adolescence and related changes, prevention of STDs, AIDs etc.

9. a. In humans, males are heterogametic and females are homogametic, Explain. Are there any examples where males are homogametic and females are heterogametic?

b. Also describe as to, who determines the sex of an unborn child? Mention whether temperature has a role in sex determination.

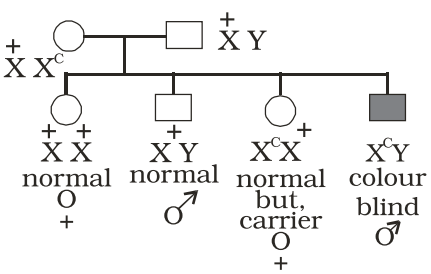
Ans.

(a) The term homogametic and heterogametic refer to the organism depending upon whether all the gametes contain one type of sex chromosome (Homo = same) or two different types of sex chromosomes (Hetero = different) Humans show XX/XY type of sex determination i.e. Females contain 2 copies of X chromosome and males contain 1 X & 1 Y chromosome. Therefore, ova produced by females contain the same sex chromosome i.e. X. On the other hand the sperms contain 2 different types of chromosomes i.e. 50% sperms have X and 50% have Y chromosome open from half the autosomes (Meiosis) Therefore, the sperms are different with respect to the composition of sex chromosome. In case of humans, females are considered to be homogametic while males are heterogametic. Yes, there are examples where males are homogametic and females are heterogametic. In some birds the mode of sex determination is denoted by ZZ (males) and ZW (females).

(b) As a rule the heterogametic organism determines the sex of the unborn child. In case of humans, since males are heterogametic it is the father and not the mother who decides the sex of the child. In some animals like crocodiles, lower temperature favour hatching of female offsprings and higher temperatures lead to hatching of male offsprings.

10. A normal visioned woman, whose father is colour blind, marries a normal visioned man. What would be the probability of her (a) sons (b) daughters to the colour blind? Explain with the help of pedigree chart.

Ans.



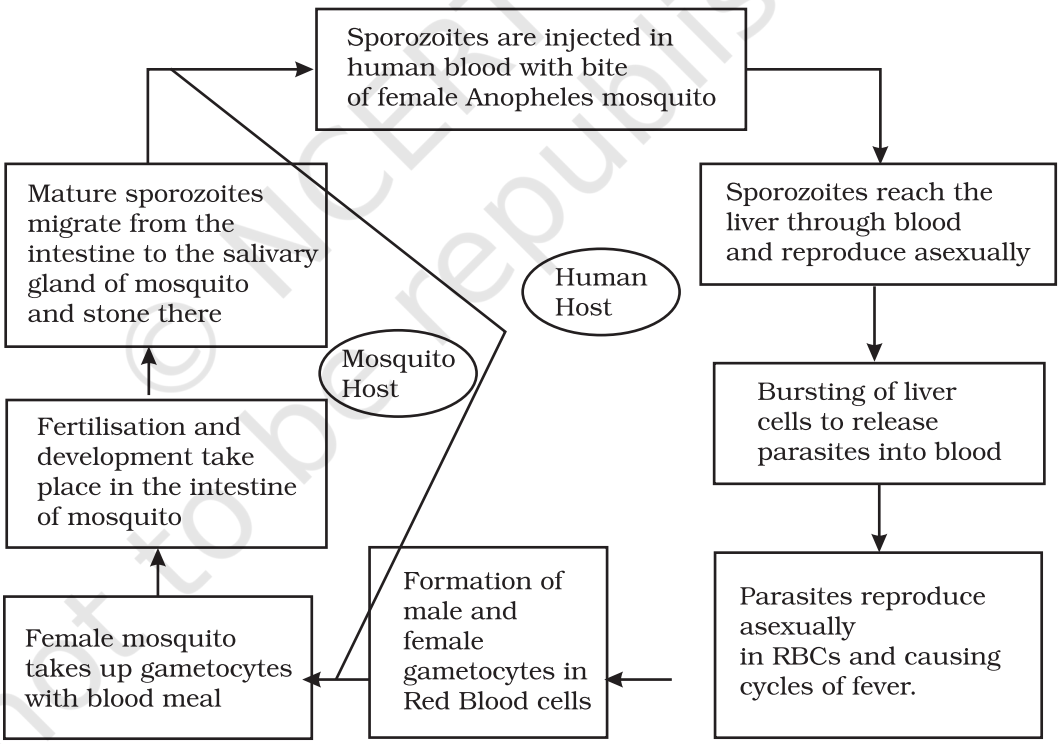
All daughters normal visioned; 50% of sons are likely to be colour blind.

11. You have studied the story of pepper moths in England. Had the industries been removed, what impact could it have had on the moth population? Discuss.

Ans. In the population of Peppermoth, 2 variants were already existing in the population, the black and the grey. In the absence of Industrialisation the grey moths were prevalent because they blended very well with the lichen and moss covered trees camouflage and the predators cannot spot them. The Black ones were easily spotted and killed by predators and therefore were fewer in numbers. With Industrilisation the stems got covered with black soot. This provided better camouflage to the black variant and their number increased. If the industries had been removed the population of black moths would have declined because as stated earlier they would have been spotted better by predators and therefore be eaten more frequently.

12. Represent schematically the life cycle of malarial parasite.

Ans.



13. Why do some adolescents start taking drugs. How can the situation be avoided?

Ans. The reasons why adolescents and youngsters take to consumption of drugs are:

(i) Curiosity of child motivates him/her to experiment.
(ii) Need for adventure and excitement.
(iii) Peer group pressure

(iv) Desire to do more physical and mental work.
(v) To overcome frustration and depression, due to failure in examinations or in other activities.
(vi) Unstable or unsupportive family structures.

The following measures can be taken to avoid taking drugs:

(i) Avoid undue pressure on child to perform beyound his/her capability in studies, sports or any other activities.
(ii) Education and counselling are very important to face problem of stress and failure in life.
(iii) Seeking help from parents, elders and peers. This would help the young to share their feelings and concern.
(iv) Looking for danger signs and taking appropriate measures to treat them.
(v) Seeking professional and medical help for de-addiction and rehabilitation.

14. (a) The shift from grain to meat diets creates more demands for cereals? Why?

(b) A 250 Kg cow produces 200 g of protein per day but 250 g of *Methylophillus methylotrophus* can produce 25 tonnes of protein. Name this emerging area of research. Explain its benefits.

Ans. (a) It takes 3–10 kg of grain to produce 1 kg of meat using animal farming. That is why cereals demand increases.

(b) Production of single cell proteins (SCP) by microbes. Microbes are being grown on an Industrial scale. *Spirulina* can be easily grown on starch, molasses etc., and can make food which is rich in proteins, minerals, fats, carbohydrates and vitamins. This could be a good alternative for dealing with the problem of malnutrition.

15. Draw a diagrammatic sketch of biogas plant, and label its various components.

Ans. Diagram of Biogas Plant from the textbooks

16. Describe critically the main ideas behind the biological control of pests and diseases.

Ans. Biological control means life against life. It's a natural and ecofriendly concept. It employs the natural organisms to control the population of pathogens and pests in an ecosystem. Classical examples are *Trichoderma* which is antagonist against many soil borne plant pathogens. Similarly, *Penicillium* inhibits the growth of *Staphylococcus* and therefore has been successfully used in the production of Penicillin antibiotic to control many human bacterial pathogens.

17. For selection of recombinants, insertional inactivation of antibiotic marker has been superceded by insertional inactivation of a marker gene coding for a chormogenic substrate. Give reasons.

Ans: Selection of recombinants due to inactivation of antibiotics is a laborious process as it requires:

(i) a vector with two antibiotic resistance marker

(ii) preparation of two kinds of media plate, with one antibiotic each.

Transformed cells are first plated on that antibiotic plate which has not been insertionally inactivated (ampicillin) and incubated overnight for growth of transformants. For selection of recombinants, these transformants are Replica plated on second antibiotic (tetracycline) plate (which got inactivated due to insertion of gene). Non-Recombinants grow on both the plates (one carrying ampicillin and the other carrying tetracycline) while recombinants will grow only on ampicillin plate.

This entire exercise is laborious and takes more time (two overnight incubation) as well. However, if we choose the second option (insertional inactivation of a marker that produces colour in the presence of a chromogenic compound), we can distinguish between the recombinants and non-recombinants on a single medium plate (containing one antibiotic and the chromogenic compound) after overnight growth.

Hence I would choose a marker which produces a coloured compound but gets inactivated due to insertion of foreign DNA.

18. Describe the role of *Agrobacterium tumefaciens* in transforming a plant cell.

Ans. *Agrobacterium tumefaciens* harbours a mega plasmid called Ti-plasmid. This has a T-DNA region flanked by left border and right border sequence. The T-DNA gets transferred and integrates with the host plant DNA. This property of Ti-plasmid has been exploited for cloning of gene of interest and stably integrating them in the plant genese. Therefore, by using Ti-plasmid or its derivatives, recombinant plant cells with desired genes of interest stably integrated in the plant genome has been successfully produced.

19. Define transgenic animals. Explain in detail any four areas where they can be utilised.

Ans. Transgenic animals are products of genetic engineering and express specific gene(s) from totally unrelated source. Following are the four main areas where they can be utilised.

1) To study normal physioslogy and development these animals can be used to study as to which factor / gene products are needed at what time of development. By expression of certain genes, they

help scientists to understand the normal gene expression at various stages of growth and development.

2) Study of Diseases

Transgenic animals can be created to serve as models for various human diseases. They also help us understand the involvement of various genes in diseases like cancer, Parkinson' disease etc.

3) Vaccine safety

Transgenic animals can be used to test vaccines like polio vaccine. Transgenic mice have shown promising results in this area and would replace the vaccine testing on monkeys in the years to come.

4) Chemical safety testing

Transgenic animals are created which are more sensitive to certain chemicals / drugs. These are used to study the toxicity or side effects of that chemical / drug. The advantage is that we get results faster.

3. You have identified a useful gene in a bacteria. Make a flow chart of the steps that you would follow to transfer this gene to a plant.

Ans. After identifying a useful gene in bacteria, following steps should be undertaken

(1) Isolation of useful gene using
Restriction Endonucleases

↓

(2) Transferring the gene to a suitable vector to create a recombinant DNA molecule

↓

(3) Transfer of these recombinant DNA molecules to the target cells

↓

(4) Screening of cells for transformation

↓

(5) Selection of transformed cells

↓

(6) Regeneration of plants from the transformed cells to get transgenic plants.

20. List the disadvantages of insulin obtained from the pancreas of slaughtered cows and pigs:

Ans. (1) Insulin being a hormone is produced in very little amounts in the body. Hence, a large number of animals need to be sacrificed for

obtaining small quantities of insulin. This makes the cost of insulin very high. [Demand being many fold higher than supply].

(2) Slaughtering of animals is also not ethical.

(3) There is potential of immune response in humans against the administered insulin which is derived from animals.

(4) There is possibility of slaughtered animals being infested with some infectious micro organism which may contaminate insulin.

21. What do you understand by the term bio-pesticide? Name and explain the mode of action of a popular bio-pesticide.

Ans. Biopesticide is a pesticide which is

a. not chemical in nature

b. more specific in action against the pest

c. safer for environment than chemical pesticides

A popularly known bio-pesticide is Bt toxin, which is produced by a bacterium called *Bacillus thuringiensis*. Bt toxin gene has been cloned from this bacterium and expressed in plants. Bt toxin protein when ingested by the insect, gets converted to its active form due to the alkaline pH of the gut. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually kills the insect.

22. Name the five key tools for accomplishing the tasks of recombinant DNA technology. Also mention the functions of each tool.

Ans.

i. Restriction endonucleases: for cutting the desired DNA at desired places

ii. Gel electrophoresis: for separating the desired DNA fragments

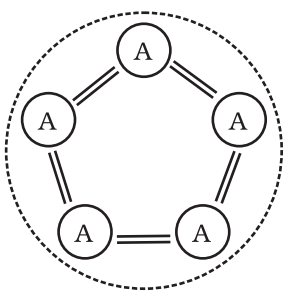
iii. Ligase enzyme: for creating recombinant DNA molecule.

iv. DNA delivery system: like electroporation, microinjection, gene gun method.

v. Competant host (usually bacteria / yeast): to take up recombinant DNA.

23. Comment on the following diagrams:

A, B, C. D, G, P, Q, R, S are species



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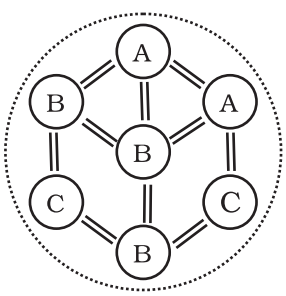

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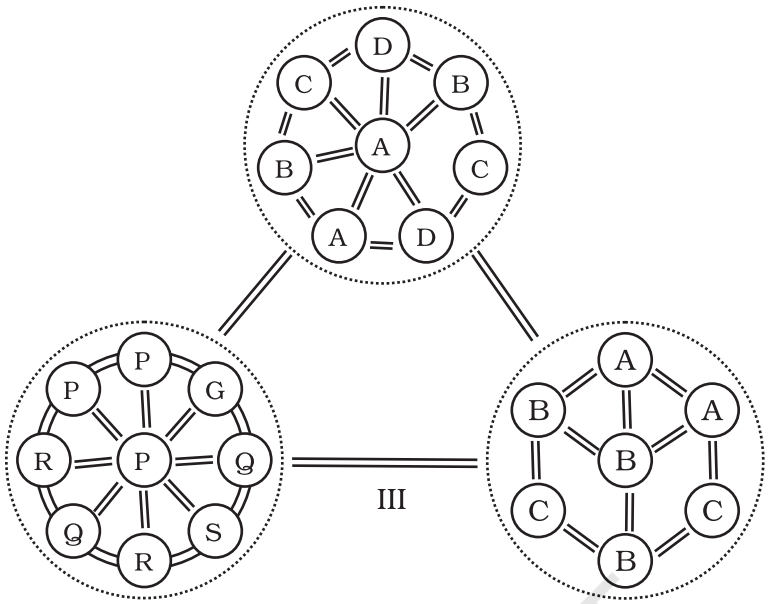


Ans.

Fig.-I: It is a single population and all individuals are of the same species i.e. A. Individual interact among themselves and their environment.

Fig.-II: It is a community and it contains three populations of species A,B and C. They interact with each other and their environment.

Fig. III: It is a biome. It contains three communities. of which one is in climax and other two are in different stages of development. All three communities are in the same environment and they interact with each other and their environment.

24. The following diagrams are the age pyramids of different populations. Comment on the status of these populations.

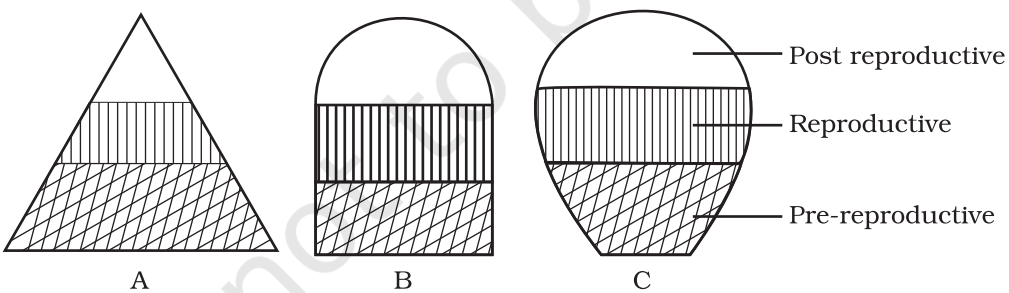


Fig.A: It is a pyramid shaped age pyramid. In this figure, the base i.e pre-reproductive stage is very large when compared with the reproductive and past reproductive stages of the population. This type of age structure indicates that the population would increase rapidly.

Fig.B: It is an inverted bell shaped pyramid. In this figure, the pre-reproductive and reproductive stages are same. This type of age structure indicates that the population is stable.

Fig.C: It is 'Urn' shaped pyramid. In this figure, the pre-reproductive and reproductive stages are less than the post reproductive stage of this population. In this population more older people are present. This type of age structure indicates that the population definitely is declining.

25. In an aquarium two herbivorous species of fish are living together and feeding on phytoplanktons. As per the Gausses principle, one of the species is to be eliminated in due course of time, but both are surviving. How? And what possibly happened to both the species?

Ans. Each species has a specific position or functional role within the community, called niche. According to the Gausses principle, no two species can live in the same niche. In this case, two herbivorous species are living in the same niche and feeding on phytoplanktons. It may be because of the availability of sufficient phytoplanktons/and or less number of individuals of the fish species. of the two species might have occured. And though neither of the species have been eliminated, niche overlapping may effect the growth and development of individuals of the species.

26. What will happen to an ecosystem if

a. All producers are removed;
b. All organisms of herbivore level are eliminated; and
c. All top carnivore population is removed

Ans. (a) Reduction in primary productivity. No biomass available for consumption by higher trophic levels / heterotrophs

(b) Increase in primary productivity and biomass of producers.
Carnivores population will subsequently dwindle due to food shortage.

(c) Increase in number of herbivores
Overgrazing by herbivores
Desertification

27. Elaborate how invasion by an alien species reduces the species diversity of an area.

Ans. Some possible explanations are that the alien species may be

i. Vigorously growing and compete with the natural plants for minerals, water etc. The less vigorous local species may be eliminated.
ii. Natural pests and predators of the alien species may not be present in the introduced area-leading to proliferation in their number.
iii. The introduced species may harm the local species by production of chemicals (Amensalism)
iv. The alien species by proliferation may make conditions unfavourable for the growth of local native plants. (eg. *Eichornia*)

28. How can you, as an individual, prevent the loss of biodiversity?

Ans. The loss of biodiversity can be prevented by

i. Practise of recycling waste paper etc.

ii. Judicious exploitation of medicinal and commercial plants and animals.

iii. Generating awareness among the public on the importance of biodiversity, conversation through skits, screening of films, lectures etc.

Teaching people how to reduce green house gases emissions, through alternate eco friendly green technologies like use of solar energy, wind energy, biogas, vermi compost, organic farming etc.

29. Write a short note on electronic waste. List the various sources of e- wastes and the problems associated with the disposal of e-waste.

Ans. Discarded unusable electronic gadgets such as computers, mobile phones, circuits, television sets, etc,, form electronic waste. These contain harmful toxic substances like heavy metals to which the unskilled manual workers are directly exposed.

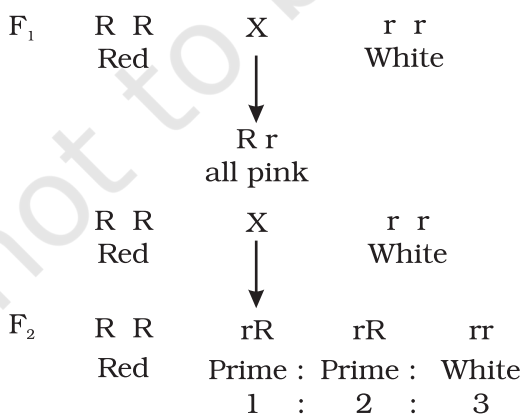
30. What are the basic characteristics of a modern land fill sites. List any three and mention the reasons for their use.

Ans. Characteristics of a modern land fill include

i) Methods to contain leachate such as lining clay or plastic liners.

iii) Compaction and covering of the waste to prevent it being blown by wind.

iv) Installation of a land fill gas extraction system to extract the gas for use in generation of power.



Phenotypic ratio:

Genotypic ratio:

Here the genotypic and phenotypic ratios are the same. So, we can conclude that when genotypic and phenotypic ratios are the same, the alleles show incomplete dominance.

18. What is Down's syndrome? Give its symptoms and cause. Why is it that the chances of having a child with Down's syndrome increases if the age of the mother exceeds forty years?

Ans. Down's syndrome is a human genetic disorder caused due to trisomy of chromosome no. 21. Such individuals are aneuploid and have 47 chromosomes. (2n + 1) The symptoms include mental retardation, growth abnormalities, constantly open mouth, dwarfness etc. The reason for the disorder is the non-disjunction (failure to separate) of homologous chromosome of pair 21 during meiotic division in the ovum. The chances of having a child with Down's syndrome increase with the age of the mother (+ 40) because ova are present in females. since their birth and therefore older cells are more prone to chromosomal non-disjunction because of various physico-chemical exposures during the mother's life-time.

19. What are the characteristic features of a true-breeding line?

Ans. A true-breeding line for a trait is one that, has undergone continuous self-pollination or brother-sister mating, showing a stability in the inheritance of the trait for several generations.

20. In peas, tallness is dominant over dwarfness, and red colour of flowers is dominant over the white colour. When a tall plant bearing red flowers was pollinated by a dwarf plant bearing white flowers, the different phenotypic groups were obtained in the progeny in numbers mentioned against them.

Tall, Red = 138
Tall, White = 132
Dwarf, Red = 136
Dwarf, White = 128

Mention the genotypes of the two parents and of the types of four offspring.

Ans. The result shows that the four types of offspring are in a ratio of 1:1:1:1. Such a result is observed in a test-cross progeny of a dihybrid cross.

The cross can be represented as:
Tall & Red (Tt Rr) × Dwarf & white (ttrr)

offsprings		tr		
Tt Rr – Tall, Red	TR	TtRr	Tall	Red
Tt rr – Tall, White	Tr	Ttrr	Tall	White
Tt Rr – dwarf, red	tR	ttRr	dwarf	Red
tt rr – dwarf, white.	tr	ttrr	dwarf	white

21. Why is the frequency of red-green colour blindness is many times higher in males than that in the females?

Ans. For becoming colourblind, the female must have the allele for it in both her X-chromosomes; but males develop colourblindness when their sole x-chromosome has the allele for it.

22. If a father and son are both defective in red-green colour vision, is it likely that the son inherited the trait from his father? Comment.

Ans. Gene for colourblindness is X-chromosome linked, and sons receive their sole from their mother, not from their father. Male-to-male inheritances is not possible for X-linked traits in humans. In the given case the mother of the child must be a carrier. (heterozygous) for colour blindness gene.

23. Retrovirus do not follow central dogma. Comment.

Ans. Genetic material of retrovirus is RNA. At the time of synthesis of protein, RNA is 'reverse transcribed' to its complementary DNA first, which is opposite to the central dogma. Hence, retrovirus are not known to follow central dogma.

24. In an experiment, DNA is treated with a compound which tends to place itself amongst the stacks of nitrogenous base pairs. As a result of which, the distance between two consecutive base increases. from 0.34nm to 0.44 nm. Calculate the length of DNA double helix (which has 2×10^9 bp) in the presence of saturating amount of this compound.

Ans. $2\times10^9 \times 0.44 \times 10^{-9}$/bp

25. What would happen if histones were to be mutated and made rich in amino acids aspartic acid and glutamic acid in place of basic amino acids such as lysine and arginine?

Ans. If histone proteins were rich in acidic amino acids instead of basic amino acids then they may not have any role in DNA packaging in eukaryotes as DNA is also negatively charged molecule. The packaging of DNA around the nucleosome would not happen. Consequently, the chromatin fibre would not be formed.

26. Recall the experiment done by Frederick Griffith. If RNA, instead of DNA was the genetic material, would the heat killed strain of *strepts* have transformed the R-strain into virulent strain? Explain your answer.

Ans. RNA is more labile and prone to degradation (owing to the presence of 2' OH group in its ribose). Hence heat-killed S-strain may not have retained its ability to transform the R-strain into virulent form if RNA was its genetic material.

27. You are repeating the Hershey-Chase experiment and are provided with two isotopes: ^{32}P and ^{15}N (in place of ^{35}S in the original experiment). How do you expect your results to be different?

Ans. Use of ^{15}N will be inappropriate because method of detection of ^{35}p and ^{15}N is different (^{32}p being a radioactive isotope while ^{15}N is not radioactive but is the heavier isotope of Nitrogen). Even if ^{15}N was radioactive then its presence would have been detected both inside the cell (^{15}N incorporated as nitrogenous base in DNA) as well as in the supernatant because ^{15}N would also get incorporated in amino group of amino acids in proteins). Hence the use of ^{15}N would not give any conclusive results.

28. There is only one possible sequence of amino acids when deduced form a given nucleotides. But multiple nucleotide sequences can be deduced from a single amino acid sequence. Explain this phenomena.

Ans. Some amino acids are coded by more than one codon (known as degeneracy of codons), hence on deducing a nucleotide sequence from an amino acid sequence, multiple nucleotide sequence will be obtained.

For e.g., Ile has three codous: AUU, AUC AUA hence a depeptide Met–Ile can have the following nucleotide sequence:

(i) AUG – AUU
(ii) AUG – AUC
(iii) AUG – AUA

and if, we deduce amino acid sequence for the above nucleotide sequences, all the three will code for Met–Ile

29. A single base mutation in a gene may not 'always' result in loss or gain of function. Do you think the statement is correct? Defend your answer.

Ans. The statement is correct. Because of degeneracy of codons, mutations at third base of codon, usually does not result into any change in phenotype. This is called silent mutations.

30. A low level of expression of lac operon occurs at all the time. Can you explain the logic behind this phenomena.

Ans. In the complete absence of expression of lac operon, permease will not be synthesised which is essential for transport of lactose from medium into the cells. And if lactose cannot be transported into the cell, then it cannot act as inducers hence, cannot relieve the lac operon from its repressed state.

31. Would it be appropriate to use DNA probes such as VNTR in DNA fingerprinting of a bacteriaphage?

Ans. Bacteriaphage does not have repetitive sequences such as VNTRs in its genome as its genome is very small and have all the coding sequence. DNA finger printing is not done for phages.

32. During in vitro synthesis of DNA, a researcher used 2', 3' – dideoxy cytidine triphosphate as raw nucleotide in place of 2'-deoxy cytidine triphosphate other conditions remaining as standard. Will further polymerisation of DNA continue upto the end or not? Explain.

Ans. Further polymerisation would not occur, as the 3' OH on sugar is not there to add a new nucleotide for forming ester bond.

33. What background information did Watson and Crick had available with them for developing a model of DNA? What was their own contribution?

Ans. Wastson and Crick had the following informations which helped them to develop a model of DNA.

(i) Chargaffs' Law suggesting A = T, and C = G.

(ii) Wilkins and Rosalind Franklin's work on DNA crystal's X-ray diffraction studies about DNA's physical structure.

(iii) Watson and crick proposed

a. How complementary bases may pair

b. Semi conservative replication and

c. Mutation through tautomerism.

34. What are the functions of (i) methylated guanasine cap, (ii) poly-A "tail" in a mature on RNA?

Ans. Methylated Guanine cap helps in binding of mRNA to smaller ribosomal sub-unit during initiation of translation. Poly– A tail provides longevity to mRNA's life. Tail length and longevity of mRNA are positively correlated.

35. Do you think that the alternate splicing of exons may enable a structural gene to code for several isoproteins from one and the same gene? If yes, how? If not, why so?

Ans. Functional mRNA of structural genes need not always include all of its exons. This alternate splicing of exons is sex-specific, tissue-specific, and even developmental stage-specific. By such alternate splicing of exons, a single gene may encode for several isoproteins and/or proteins of similar class. In absence of such a kind of splicing, there should have been new genes for every protein/isoprotein. Such an extravagancy has been avoided in natural phenomena by way of altemate splicing.

36. Comment on the utility of variability in number of tandem repeats during DNA finger printing.

Ans. Tandemness in repeats provides many copies of the sequence for finger-printing, and variability in nitrogen base sequence in them. Being individual-specific, this proves to be useful in the process of DNA fingerprinting.

37 Scientists claim that nascent oxygen is toxic to aerobic life forms. What are the reasons.

Ans. Nascent oxygen is highly reactive. It can react readily with different kinds of molecules, including DNA, proteins present in the cells of aerobic life forms. This may lead to mutations and undesirable metabolic changes.

38. While creation and presence of variation is directionless, natural selection is directional as it is in the context of adaptation. Comment.

Ans. Creation and variation occur in a sexually reproducing population as a result of crossing over during meiosis and random fusion of gametes. It is however the organisms that are selected over a period of time which are determined by the environmental conditions. In other words, the environment provides the direction with respect to adaptations so that the organisms are more and more fit in terms of survival.

39. Gene flow occurs through generations. and can occur across language barriers in humans. If we have a technique of measuring specific allele frequencies in different population of the world, can we not predict human migratory patterns in pre-history and history? Do you agree or disagree? Provide explanation to your answer.

Ans. Yes, I agree. Gene flow occurs through generations. By studying specific allele frequencies, we can predict the human migratory patterns in pre-history and history. Studies have used specific genes/chromosomes/ mitochondrial DNA to trace the evolutionary history and migratory patterns of humans. (The project is known as the Human Genographics Project).

40. When we say "survival of the fittest", does it mean that

a. Those which are fit only survive, or
b. Those that survive are called fit

Comment.

Ans. Those individuals which survive and reproduce in their respective environment are called fit.

41. Enumerate three most characteristic criteria for designating a Mendelian population.

Ans. Population must be sufficiently large with potentialities for free flow of genetic material among individuals (through sexual reproduction). Migration should either be nil or negligible.

42. "Migration may enhance or blurr the effects of selection". Comment.

Ans. Migration may cause enrichment of the gene pool of such alleles that are being selected for or anull the effects of selection through replishment of alleles that were selected against by nature.

43. From which plant are Cannabinoids obtained? Name any two Cannabinoids. Which part of the body is effected by consuming these substances?

Ans. Cannabinoids are obtained from the inflorescence of the plant *Cannabis sativa*. Marijuana, hashish, charas, ganja are some Cannabinoids.

These chemicals interact with Cannabinoid receptors of the body, mainly present in the brain. Cardiovascular system is effected adversely.

44. In the metropolitan cities of India, many children are suffering from allergy/asthma. What are the main causes of this problem. Give some symptoms of allergic reactions.

Ans. Allergy is the exaggerated response of the immune system of certain antigens present in the environment. In metropolitan cities life style is responsible in lowering of immunity and sensitivity to allergens. More polluted environment increases the chances of allergy in children.
Some symptoms of allergic reactions are sneezing, watery eyes, running nose and difficulty in breathing.

45. What is the basic principle of vaccination? How do vaccines prevent microbial infections? Name the organism from which hepatitis B vaccine is produced.

Ans. The principle of vaccination is based on the property of `memory' of the immune system. In vaccination, a preparation of antigenic proteins of pathogens or inactivated/live but weakened pathogens is introduced into the body. The antigens generate the primary immune response by producing antibodies. The vaccines also generate the memory B-cells and T-cells. When the vaccinated person is attacked by the same pathogens, the existing memory B-cells or T-cells recognises the antigen quickly and overwhelm the invaders with massive production of lymphocytes and antibodies. Hepatitis B vaccine is produced from yeast.

46. What is Cancer? How is a Cancer cell different from normal cell? How do normal cells attain Cancerous nature?

Ans. An abnormal and uncontrolled division of cells is termed as Cancer.

The Cancerous cells are different from the normal cells in the following ways.

Cancer Cells	**Normal Cells**
1. Cancer cells divide in an uncontrolled manner.	1. Normal cells divide in a controlled manner.
2. The cells do not show contact inhibition	2. The cells show contact inhibition.
3. Life span is indefinite	3. Life span is definite.

In our body, the growth and differentiation of cells is highly controlled and regulated. The normal cells show a property called contact inhibition. The surrounding cells inhibits uncontrolled growth and division of cells. The normal cells lose this property and become cancerous cells giving rise to masses of cells called tumors. Transformation of normal cells into cancerous cells is induced by some physical, chemical and biological agents (carcinogens).

47. A person shows strong unusual hypersensitive reactions when exposed to certain substances present in the air. Identify the condition. Name the cells responsible for such reactions. What precaution should be taken to avoid such reactions.

Ans. Allergy. Mast Cells are responsible for such reactions.

To avoid such reactions following precautions must be taken.

(i) The use of drugs like antihistamine, adrenalin and steroids quickly reduce the symptoms of allergy.

(ii) Avoid contact with substances to which a person is hypersensitive.

48. Life style diseases are increasing alarmingly in India. We are also dealing with large scale malnutrition in the population. Is there any method by which we can address both these problems?

Ans. The answer to address both these problems is called biofortification. This area looks at improving food quality with respect to protein, oil, vitamin, micro nutrient and mineral content. The oils need to be rich in omega 3 fatty acids which are good for heart. Similarly, proteins should have more of lysine and tryptophan (essential amino acids). Many varieties of maize, carrots and spinach have been released which fulfil the above criteria.

49. How can we improve the success rate of fertilisation during artificial insemination in animal husbandry programmes?

Ans. The technology is called MOET or Multiple Ovulation Embryo Transfer. During the procedure, a cow is given hormonal treatment so that more than one ovule (6-8 eggs) is produced per cycle. After mating or artificial insemination the embryos at 8-32 celled state are transferred to different surrogate mother cows. The method has been successfully used for cattle, sheep, buffalo etc.

50. What is meant by germplasm collection? What are its benefits?

Ans. The collection of all the diverse alleles of all the genes of a crop plant is called germplasm collection. It is of great benefits in plant breeding programmes as it offers, to the breeders, the entire of genes and alleles and the characteristics which they express. The breeder selects the most favourable characters of a particular gene and manipulates its transfer to a desirable parent.

51. Name the three improved characteristics of wheat that helped India achieve green revolution.

Ans.
i. Semi-dwarf nature
ii. Quick yielding feature
iii. High yielding feature
iv. Disease resistant feature

52. Suggest two features of plants that will prevent insect and pest infestation

Ans.
i. increasing hair growth on aerial parts of plants.
ii. Rendering the flowers nectar less.
iii. Enabling plants to secrete insect killing chemicals (toxins)

53. What are the physical barriers of a cell in the protoplast fusion experiment? How are the barriers overcome?

Ans. Cell wall is the most important physical barrier in such experiments. This can be overcome by treatment with enzymes like cellulose and pectinase which have the ability to digest the cell wall and liberate the naked protoplast surrounded only by the cell membrane.

54. Give two examples of biofortified crops. What benefits do they offer to the society?

Ans. Maize, wheat, rice, bathua, spinach, pulses have biofortified varieties. Maize hybrids have twice the amount of amino acids, fortified wheat variety has high protein content, fortified rice has high quantity of iron. Consumption of such biofortified foods will enrich the nutritive value of our common foods and will vastly improve public health. Instead of consuming different food items for obtaining different nutrients, if 2 or 3 nutrients can be incorporated into a single crop, it offers enormous benefits to human beings and may even help cover come several nutrient deficiency disorders latent in our country.

55. How has the bacterium *Bacillus thuringiensis* helped us in controlling caterpillars of insect pests?

Ans. *Bacillus thuringiensis* products are endotoxin which when ingested and released in the gut of the larvae of insect pest disrupts the insect gut lining thereby killing them.

56. How do mycorrhizal fungi help the plants harbouring them?

Ans. The mycorrhizal fungi absorb phosphorus from the soil and transfer them to the host cells. They also impart resistance to host plants against root pathogens. They also help plant tolerate salinity and draught.

57. How was penicillin discovered?

Ans. Penicillin was an accidental discovery. Sir Alexander Fleming observed that in unwashed culture plates of *Staphylococcus,* a mould *Penicillium* was growing This mould inhibited the growth of *Staphylococcus* . Latre the antibitic *Penicillin* was isolated from this fungus.

58. What is the chemical nature of biogas. Name an organism which is know to be employed in biogas?

Ans. The chemical nature of Biogas is methane, CO_2 & H_2. *Methanobacteria,* a type of methonogen is employed for biogas production.

59. What is a broad spectrum antibiotic? Name a broad spectrum antibiotic and source organism.

Ans. A broad spectrum antibiotic is one which can inhibit the growth of both G +ve & G -ve bacteria.

60. What do you understand by gene cloning?

Ans. Gene cloning refers to a process in which a gene of interest is ligated to a vector. The recombinant DNA thus produced is introduced in a host cell by transformation. Each cell gets one DNA molecule and when the transformed cell grows to a bacterial colony, each cell in the colony has a copy of the gene. This is precisely gene cloning.

61. A wine maker and a molecular biologist who has developed a recombinant vaccine, both claim themselves to be biotechnologist. Who in your opinion is right?

Ans. Both. As biotechnology is a very wide area which deals with techniques of using a 'natural' organism (or its parts) as well as genetically modified organism to produce products and processes useful for mankind. A wine maker employs a strain of yeast to produce wine by fermentation (a natural phenomenon), while the molecular biologist has cloned gene for the antigen (that is used as vaccine) in an organism which allows the production of the antigen in large amount.

62. You have created a recombinant DNA molecule by ligating a gene to a plasmid vector. By mistake, your friend adds exonuclease enzyme to the tube containing the recombinant DNA. How will your experiment get affected as you plan to go for transformation now?

Ans. The experiment will not likely to be affected as recombinant DNA molecule is circular closed, with no free ends. Hence, it will not be a substrate for exonuclease enzyme which removes nucleotides from the free ends of DNA.

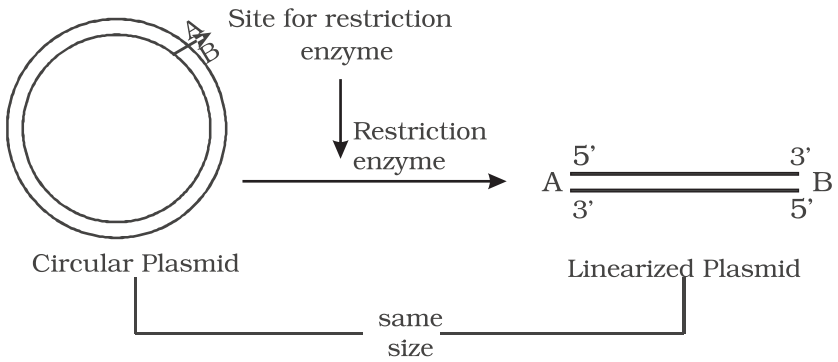
63. The restriction enzymes that are used in construction of recombinant DNA molecule are endonucleases which cut the DNA at 'specific-recognition sequence'. What would be the disadvantage if they would not cut the DNA at specific-recognition sequence?

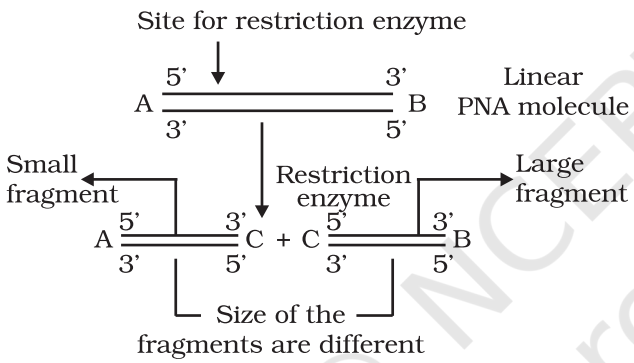
Ans. If the restriction enzymes would cut DNA at random sites instead of at specific sites, then the DNA fragments obtained will not have 'sticky ends'. In the absence of sticky ends, construction of recombinant DNA molecule would not be possible.

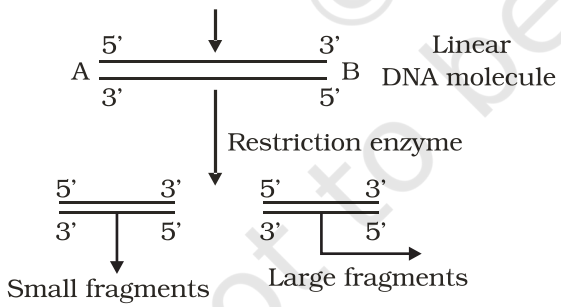
64. A plasmid DNA and a linear DNA (both of the same size) have one site for a restriction endonuclease. When cut and separated on agarose gel electrophoresis, plasmid shows one DNA band while linear DNA shows two fragments. Explain.

Ans. It is because plasmid is a circular DNA molecule. When cut with enzyme, it becomes linear but does not get fragmented. Whereas, a linear DNA

molecule gets cut into two fragment. Hence, a single DNA band is observed for plasmid while two DNA bands are observed for linear DNA in agarose gel.







65. How do you visualise DNA on an agarose gel?

Ans. A compound called Ethidium Bromide stains DNA, which on irradiating with Ultra Violet, fluoresce and gives orange light. Hence, DNA fragments appear as orange band in the presence of Ethidium Bromide and UV.

66. You have chosen a plasmid as vector for cloning your gene. However this vector plasmid lacks a selectable marker. How would it affect your experiment?

Ans. In a gene cloning experiment, first a recombinant DNA molecule is constructed, where the gene of interest is ligated to the vector, [The step would not be affected] and introduced inside the host cell (transformation). Since, not all the cells get transformed with the recombinant / plasmid DNA, in the absence of selectable marker, it will be difficult to distinguish between transformants and non-transformant, because role of selectable marker is in the selection of transformants.

67. A mixture of fragmented DNA was electrophoresed in agarose gel. After staining the gel with ethidium bromide, no DNA bands were observed. What could be the reason?

Ans. The reasons are as follows:

(i) DNA sample that was loaded on the gel may have got contaminated with nuclease (exo-or endo-or both) and completely degraded.

(ii) Electrodes were put in opposite orientation in the gel assembly that is anode towards the wells (where DNA sample is loaded). Since DNA molecules are negatively charged, they move towards anode and hence move out of the gel instead of moving into the matrix of gel.

(iii) Ethidium bromide was not added at all or was not added in sufficient concentration and DNA was not visible.

68. Describe the role of $CaCl_2$ in preparation of competent cells?

Ans. $CaCl_2$ is known to increase the efficiency of DNA uptake to produce transformed bactrial cells. The divalent Ca^{+2} ions supposedly create transient pores on the bactrial cell wall by which the entry of foreign DNA is facilitated into the bactrial cells.

69. What would happen when you grow a recombinant in a bioreactor but forget to add antibiotic to the medium in which the recombinant is growing.

Ans. In the absence of antibiotic, there will be no pressure on recombinants to retain the plasmid (containing the gene of your interest). Since, maintaining a high copy number of plasmids is a metabolic burden to the microbial cells, will thus tend to lose the plasmid.

70. Gene expression can be controlled with the help of RNA molecule. Explain the method with an example.

Ans. Gene expression can be controlled by using RNA molecule. The technology is called RNA interference or RNAi. It is used to block the expression of certain genes and also referred to as gene silencing. During this process a complementary RNA to the mRNA being produced by the gene is introduced into the cell. This RNA binds to the mRNA making it double stranded and therefore stops translation. Resistance to nematode *Meloidegyne incognita* in tomato has been achieved by this method.

71. Define the terms Antigen and Antibody. Name any two diagnostic kits based upon them.

Ans. An antigen is a foreign substance that elicits the formation of an antibody. Antibody is a protein that is synthesised in response to an antigen. Antigen and antibody show high degree of specificity in binding each other Two diagnostic kits based on a ntigen-antibody interaction are.

a. ELISA for HIV.
b. Pregnancy test kits.

72. ELISA technique is based on the principles of antigen and antibody interaction. Can this techique be used in *the molecular* diagnosis of a genetic disorder, such as phenyketonuria?

Ans. Yes. One can use antibody against the enzyme (that is responsible for the metabolism of phenylalanine) to develop ELISA based diagnostic technique. The patient where the enzyme protein is absent would give negative result in ELISA when compared to normal individual.

73. How is a mature, functional insulin hormone different from its pro-hormone form?

Ans. Mature functional insulin is obtained by processing of pro-hormone which contains extra peptide called C-peptide. This C-peptide is removed during maturation of pro-insulin to insulin.

74. Gene therapy is an attempt to correct a genetic defect by providing a normal gene into the individual. By this the normal function can be restored. Alternate method would be to provide the gene product (protein/ enzyme) know as enzyme replacement therapy, which would also restore the function. Which in your opinion is a better option? Give reason for your answer.

Ans. Gene therapy would be a better option because it has the potential to completely cure the patient. It is because the correct gene once introduced in the patient, can continue to produce the correct protein / enzyme. Enzyme therapy does not offer permanent cure as it needs to be given to the patient on regular basis. It is also more expensive therepy.

75. Transgenic animals are the animals in which a foreign gene is expressed. Such animals can be used to study the fundamental biological process/ phenomenon as well as for producing products useful for mankind. Give one example for each type.

Ans. Study basic biological process- how gene are regulated, how they affect the normal functions of the body and its development. Transgenic cow, Rosie is the example for the second category.

76. When a foreign DNA is introduced in to an organism, how it is maintained in the host and how it is transferred to the progeny of the organism?

Ans. Foreign gene is usually ligated to a plasmid vector and introduced in the host. As plasmid replicates, and makes multiple copies of itself, so does the foreign gene gets replicated and its copes are made. When the host organism divides, its progeny also receives the plasmid DNA containing the foreign gene.

77. Bt cotton is resistant to pest, such as lepidopteron, dipterans and coleopterans. Is Bt cotton resistant to other pests as well?

Ans. Bt cotton is made resistant to only certain specific taxa of pests. It is quite likely that in future, some other pests may infest this Bt cotton plants. It is similar immunisation against small-pox which does not provide immunity against other pathogens like those that causes cholera, typhoid etc.

78. Why are coral reefs not found from West Bengal to Andhra Pradesh but found in Tamil Nadu on the east coast of India?

Ans. High salinity, optimal temperature and less siltation are essential to colonise corals. If siltation and fresh water inflow are very high, the corals don't colonise. In contrast when the siltation and fresh water inflow by the rivers are very less, the coral do colonise.

79. In a sea shore, the benthic animals live in sandy, muddy and rocky substrata and accordingly developed the following adaptations. Find the suitable substratum against each adaptation.

a. Burrowing _____
b. Building cubes _____
c. Holdfasts / peduncle _____

Ans. a. Sandy, b. Muddy, c. Rocky

80. Plants living in the water are called hydrophytes, Those living in the areas with water scarcity are called xerophytes; and the plants living in saline waters are called halophytes. Write the type of plant against the following examples.

a. *Salvinia* _____
b. *Opuntia* _____
c. *Rhizophora* _____
d. *Mangifera* _____

Ans. a. Hydrophyte, b. Xerophyte, c. Halophyte, d. Mesophyte

81. In a pond, we see plants which are free-floating; rooted–submerged; rooted emergent; rooted with floating leaves; Write the type of plant against the following examples.

a. *Hydrilla* _____
b. *Typha* _____

c. *Nymphaea* _____

d. *Lemna* _____

e. *Vallisnaria* _____

Ans. a. submerged, b. Rooted emergent, c. Rooted with floating leaves, d. free – floating, e. Rooted Submerged

82. Number of individuals of a population in a habitat per unit area is called density and density is measured in different units. Write the unit of measurement against the following:

a. Bacteria

b. Grass

c. Banyan

d. Deer

e. Fish

Ans. a. Nos. / Vol; b. Coverage / area; c. Biomass / area; d. Nos. / area; e. Wt. / area

83. What is a tree line?

Ans: When we go up the altitude, beyond a particular height no trees are found and the vegetation comprises only of shrubs and herbs. The altitude beyond which no tree is seen is known as tree line.

84. Is it Possible to achieve 'zero population growth rate? If yes, what kind of age pyramid is obtained?

Ans. Yes. An inverted bell shaped age pyramid is obtained. The young of pre reproductive age group individuals are less in number and both pre- reproductive and reproductive stages are in the same level.

85. The number of trophic levels in an ecosystem are limited. Comment.

Ans. In a food chain, only 10% of the total amount of energy is passed on to the next trophic level from the previous trophic level. So, there is a decrease in the amount of energy available at the successive trophic levels. As we move higher up in the food chain the amount of energy diminishes to a level at which it cannot sustain any trophic level, thereby limiting the number of trophic levels.

86. What could be the reason for the fast rate of decomposition in the tropics?

Ans. The rate of decomposition is regulated by climatic factors like temperature and soil moisture as they have an effect on the activities of soil microbes. The tropics with its hot and humid climatic condition provides an environment which is ideal for the microbes to speed up the process of decomposition.

87. Flow of energy through various trophic levels in an ecosystem is unidirectional and non cyclic. Explain.

Ans. The energy from the sun reaches the food chain through the primary producers (plants). This energy is passed on through successive trophic levels in the food chain. The energy transfer in the food chain follows the 10 percent law where in only 10% of the energy is transferred from one trophic level to the next successively. So, the movement of energy is only in one direction from lower to higher trophic level.

88. Apart from plants and animals, microbes form a permanent biotic component in an ecosystem. While plants have been referred to as autotrophs and animals as heterotrophs, what are microbes referred to as? How do these microbes fulfil their energy requirements?

Ans. Microbes are referred to as heterotrophs and saprotrophs. They fulfil their energy requirement by feeding on dead remains of plants and animals through the process of decomsposition.

89. Primary productivity varies from ecosystem to ecosystem. Explain?

Ans. Primary productivity varies from ecosystem to ecosystem because it depends on the plant species inhabiting the area and their photosynthetic activity. It also depends on various environmental factors.

90. Sometimes due to biotic/abiotic factor the community remains in a particular seral stage (Pre climax) without reaching the climax. Do you agree with this statement. If yes give a suitable example.

Ans. It is true that any change in the abiotic/biotic factor will arrest a particular seral stage leading to a pre climax condition before the climax stage is achieved. This can happen in cases of forest fires, landslides, changes in soil characteristics, increase in herbivore population leading to overgrazing.

91. What is an incomplete ecosystem? Explain with the help of a suitable example.

Ans. An ecosystem is a functional unit with biotic and abiotic factors interacting with one another resulting in a physical structure. Absence of any component will make an ecosystem incomplete as it will hinder the functioning of the ecosystem. Exampler of such an ecosystem can be a fish tank or deep aphotic zone of the oceans where producers are absent.

92. What are the shortcomings of ecological pyramids in the study of ecosystem?

Ans. The ecological pyramid assumes a simple food chain and does not accommodate food webs. Thereby, it does not take into account the fact that species may belong to two or more trophic levels at a time. Also

saprophytes despite their vital role in ecosystem are given no place in the ecological pyramids.

93. The rate of decomposition of detritus is affected by the abiotic factors like availability of oxygen, pH of the soil substratum, temperature etc. Discuss.

Ans. The decomposition of detritus is due to activities of micro organisms. The rate of growth of microbes is affected by temperature. The pH of subtratum affects the composition of microbes (acidophiles / basophiles) which degrade the dead organic matter. If oxygen is present, aerobic degradation occurs. In the absence of oxygen anaerobiosis sets in and there will be incomplete degradation. Also, the degradation is due to activity of exo enzymes secreted by the microbes and the activity of enzyme is affected by factors such as temperature etc.

94. How is the presently occurring species extinction different from the earlier mass extinctions?

Ans. Species extinction occuring at present is due to anthropogenic causes whereas the earlier extinction was due to natural causes.

95. Discuss one example, based on your day-to-day observations, showing how loss of one species may lead to extinction of another.

Ans. In case a species (x) becomes extinct, the plant and animal species (M, N, O, Z) associated within an obligatory way also become extinct. For example.

(i) When a fish species which is a host for a number of parasites becomes extinct the parasite species which are uniquely dependent on the host fish will also become extinct.

(ii) The insects may be polyphagous (feed on more than one plant species) or monophagous (feed on only one particular plant species) in nature. The monophogous insect species are valuable and may become extinct if the plant species upon which it feeds becomes extinct.

96. Why are conventional methods not suitable for the assessment of biodiversity of bacteria?

Ans. Many bacteria are not culturable under normal conditions in the laboratory. This becomes a problem in studying their morphological, biochemical and other characterisations which are useful for their assessment.

97. How do scientists extrapolate the total number of species on Earth?

Ans. Scientists make a statistical comparison of the temperate-tropical species richness of an exhaustively studied group of insects and extrapolate this ratio to other groups of animals and plants to come up with a gross estimate of the total number of species on earth.

98. Is it true that there is more solar energy available in the tropics? Explain briefly.

Ans. As one moves from the equator to the polar regions, the length of the day decreases and the length of the night increases. The length of day and night are the same at the equator.

99. What is hybrid vehicle technology. Explain the advantages with a suitable example?

Ans. Vehicles running on dual mode like petrol and CNG are hybrid vehicle. As CNG is a green fuel there is conservation of fossil fuels and reduction in the environmental pollution.

100. Is it true that if the dissolved oxygen level drops to zero the water will become septic. Give an example which could lower the dissolved oxygen content of an aquatic body.

Ans. Yes, the water become septic if the dissolved oxygen drops to zero. Organic pollution (biodegradable) is an example.

101. Name any one of the green house gases and its possible source of production on a large scale. What are the harmful effects of it?

Ans. CO_2 and Methane. CO_2 levels are increasing due to burning of fossil fuels, leading to Global Warming.

102. It is a common practice to plant trees and shrubs near the boundary walls of buildings. What purpose do they serve.

Ans. The plants growing near the boundary wall act as barriers for sound pollution and act as dust catchers.

ANSWERS TO LA TYPE QUESTIONS

1. Do all the gametes formed from a parent organism have the same genetic composition? Are the DNA in them identical copies of the parental genome? Analyse the situation with the background of gametogenesis and provide suitable explanation.

Ans. The gametes of a parent do not have the same genetic composition because they do not have identical copies of DNA. In the pachytene and diplotene stages of meiosis I, the phenomenon of crossing over and chiasma formation take place between homologous chromosomes. This shifts segments of DNA from one chromatid to another (homologous chromosomes) in a random manner resulting in several new combinations of DNA sequences. As a result, when meiotic division is completed, gametes possess DNA with varying degree of variations.

2. Although sexual reproduction is a long drawn, energy-intensive complex form of reproduction, many groups of organisms in Kingdom Animalia and Plantae prefer this mode of reproduction. Give atleast three reasons for this.

Ans.
a. Sexual reproduction brings about variation in the offspring.
b. Since gamete formation is proceded by meiosis, genetic recombination occurring during crossing over (meiosis-I), leads to a great deal of variation in the DNA of gametes.
c. The organism has better chances survival in a changing environment.

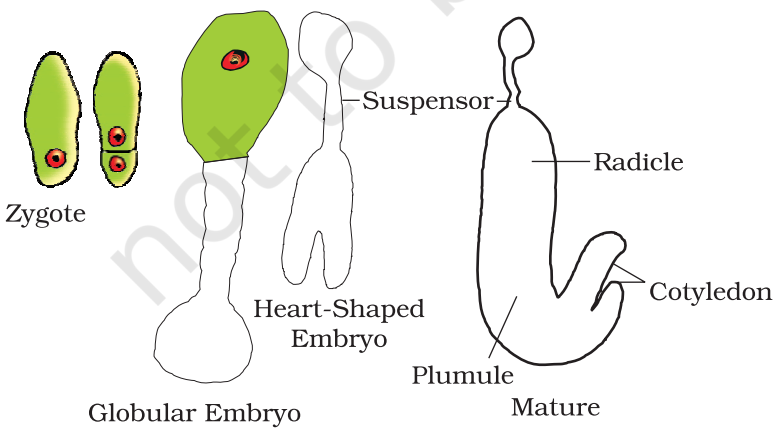
3. Rose plants produce large, attractive bisexual flowers but they seldom produce fruits. On the other hand Lady's finger produces plenty of fruits. Analyse the reasons for failure of fruit formation in rose.

Ans. Failure of fruit formation in rose may be due to several reasons. Some of the likely reasons are:

a. Rose plants may not produce viable pollen.
b. Rose plants may not have functional egg.
c. Rose plants may have abortive ovules.
d. Being hybrids, the meiotic process may be abnormal resulting in non-viable gametes.
e. There may be self-incompatibility.
f. There may be internal barriers for pollen tube growth and/or fertilisation.

4. Starting with the zygote, draw the diagrams of the different stages of embryo development in a dicot.

Ans.



5. Embryo sacs of some apomictic species appear normal but contain diploid cells. Suggest a suitable explanation for the condition.

Ans. It is true that many apomicts posses normal looking embryo sacs. The only possibility of the embryo sac possessing diploid cells is due to failure of meiotic division at the megaspore mother cell stage. Since, the megaspore mother cell has a dipoid nucleus, if it undergoes mitosis instead of meiosis, all the resulting nuclei and cells will be diploid in nature.

6. What role does pituitary gonadotrophins play during follicular and ovulatory phases of menstrual cycle and also explain the shift in steroidal secretions.

Ans. Menstrual cycle is regulated by hypothalamus through the pituitary gland. At the end of menstrual phase, the pituitary FSH gradually increases resulting in follicular development within the ovaries. As the follicles mature, Estrogen secretion increases resulting in a surge in (FSHe and LH) The surge of LH15 responsible for ovulation. LH also gonadotropins induces luteinisation. This leading to the formation of corpus luteum. Corpus luteum secretes progesterone and source estrogen which help in maintaining the interine endometrium for implantation.

7. Meiotic division during oogenesis is different from that in spermatogenesis. Explain how and why?

Ans. Unequal cytoplasmic diversion of the oocyte is to ensure the retention of bulk of cytoplasm in one cell, instead of sharing it with two. It has to provide nourishment for the developing embryo during early stages, so it is essential to retain as much cytoplasmic materials it could in a single daughter cell.

8. Enumerate and describe any five reasons for introducing sex-education to school-going children.

Ans. Proper information about reproductive organs-physiology and its functioning; discourage myths and misconceptions about sex-related aspects; knowledge about safe and hygienic sexual practices; adolescence and related changes, prevention of STDs, AIDs etc.

9. a. In humans, males are heterogametic and females are homogametic, Explain. Are there any examples where males are homogametic and females are heterogametic?

b. Also describe as to, who determines the sex of an unborn child? Mention whether temperature has a role in sex determination.

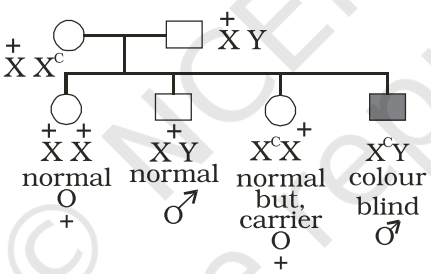
Ans. (a) The term homogametic and heterogametic refer to the organism depending upon whether all the gametes contain one type of sex chromosome (Homo = same) or two different types of sex chromosomes (Hetero = different) Humans show XX/XY type of sex determination i.e. Females contain 2 copies of X chromosome and males contain 1 X & 1 Y chromosome. Therefore, ova produced by females contain the same sex chromosome i.e. X. On the other hand

the sperms contain 2 different types of chromosomes i.e. 50% sperms have X and 50% have Y chromosome open from half the autosomes (Meiosis) Therefore, the sperms are different with respect to the composition of sex chromosome. In case of humans, females are considered to be homogametic while males are heterogametic. Yes, there are examples where males are homogametic and females are heterogametic. In some birds the mode of sex determination is denoted by ZZ (males) and ZW (females).

(b) As a rule the heterogametic organism determines the sex of the unborn child. In case of humans, since males are heterogametic it is the father and not the mother who decides the sex of the child. In some animals like crocodiles, lower temperature favour hatching of female offsprings and higher temperatures lead to hatching of male offsprings.

10. A normal visioned woman, whose father is colour blind, marries a normal visioned man. What would be the probability of her (a) sons (b) daughters to the colour blind? Explain with the help of pedigree chart.

Ans.



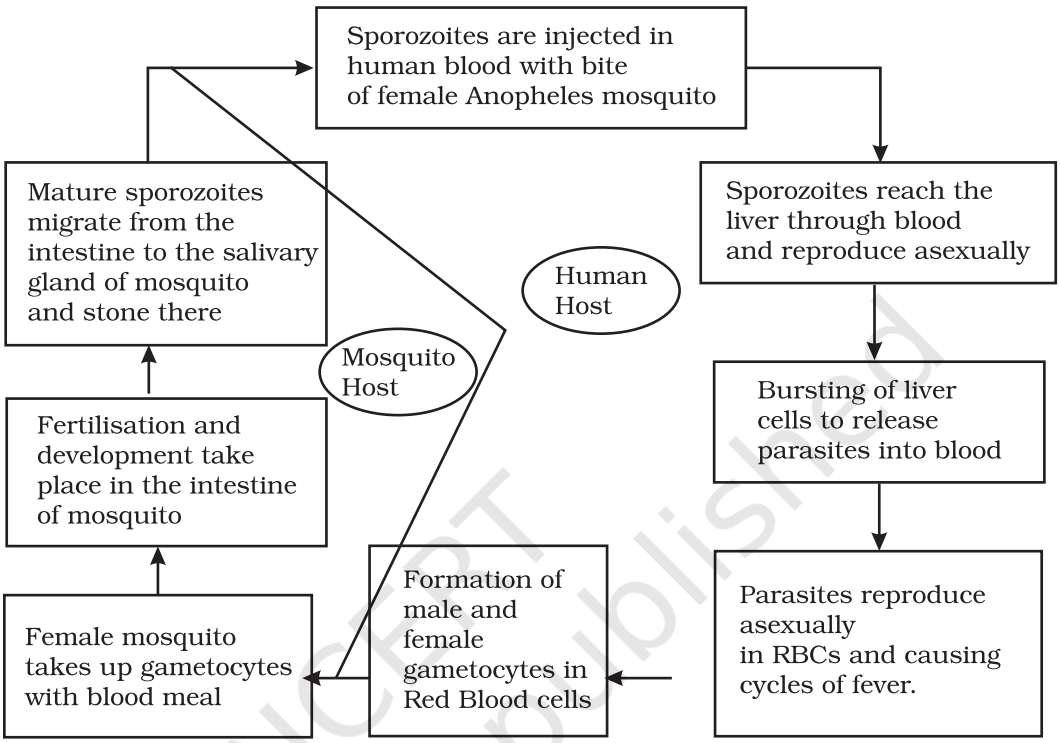
All daughters normal visioned; 50% of sons are likely to be colour blind.

11. You have studied the story of pepper moths in England. Had the industries been removed, what impact could it have had on the moth population? Discuss.

Ans. In the population of Peppermoth, 2 variants were already existing in the population, the black and the grey. In the absence of Industrialisation the grey moths were prevalent because they blended very well with the lichen and moss covered trees camouflage and the predators cannot spot them. The Black ones were easily spotted and killed by predators and therefore, were fewer in numbers. With Industrilisation the stems got covered with black soot. This provided better camouflage to the black variant and their number increased. If the industries had been removed the population of black moths would have declined because as stated earlier they would have been spotted better by predators and therefore be eaten more frequently.

12. Represent schematically the life cycle of malarial parasite.

Ans.



13. Why do some adolescents start taking drugs. How can the situation be avoided?

Ans. The reasons why adolescents and youngsters take to consumption of drugs are:

i. Curiosity of child motivates him/her to experiment.
ii. Need for adventure and excitement.
iii. Peer group pressure.
iv. Desire to do more physical and mental work.
v. To overcome frustration and depression, due to failure in examinations or in other activities.
vi. Unstable or unsupportive family structures.

The following measures can be taken to avoid taking drugs:

i. Avoid undue pressure on child to perform beyound his/her capability in studies, sports or any other activities.
ii. Education and counselling are very important to face problem of stress and failure in life.
iii. Seeking help from parents, elders and peers. This would help the young to share their feelings and concern.
iv. Looking for danger signs and taking appropriate measures to treat them.

v. Seeking professional and medical help for de-addiction and rehabilitation.

14. a. The shift from grain to meat diets creates more demands for cereals? Why?

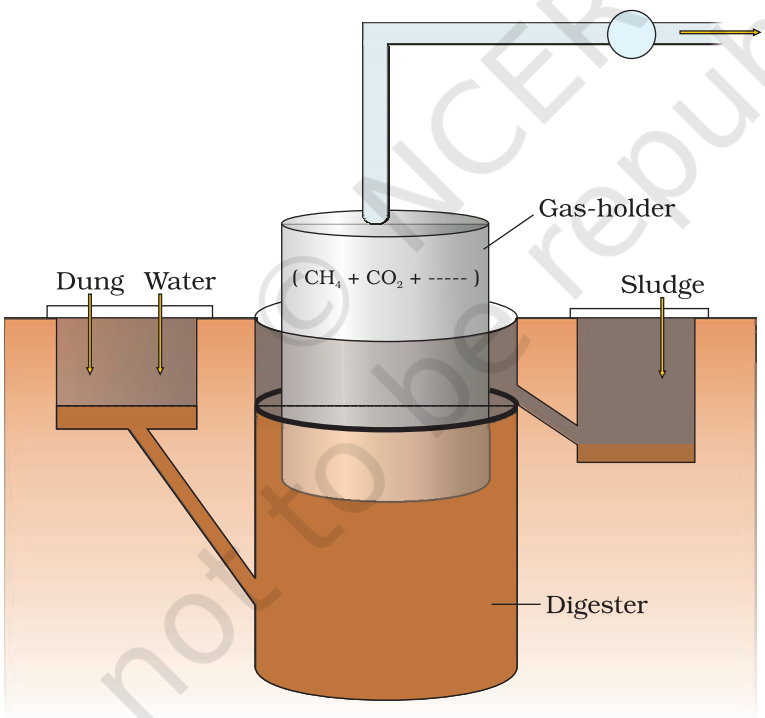
b. A 250 Kg cow produces 200 g of protein per day but 250 g of *Methylophillus methylotrophus* can produce 25 tonnes of protein. Name this emerging area of research. Explain its benefits.

Ans. a. It takes 3–10 kg of grain to produce 1 kg of meat using animal farming. Thas is Why cereals demand increases.

b. Production of single cell proteins (SCP) by microbes. Microbes are being grown on an Industrial scale. *Spirulina* can be easily grown on starch, molasses etc., and can make food which is rich in proteins, minerals, fats, carbohydrates and vitamins. This could be a good alternative for dealing with the problem of malnutrition.

15. Draw a diagrammatic sketch of biogas plant, and label its various components.

Ans. Diagram of Biogas Plant from the textbooks



16. Describe critically the main ideas behind the biological control of pests and diseases.

Ans. Biological control means life against life. It's a natural and ecofriendly concept. It employs the natural organisms to control the population of pathogens and pests in an ecosystem. Classical examples are

Trichoderma which is antagonist against many soil borne plant pathogens. Similarly, *Penicillium* inhibits the growth of *Staphylococcus* and therefore has been successfully used in the production of Penicillin antibiotic to control many human bacterial pathogens.

17. For selection of recombinants, insertional inactivation of antibiotic marker has been superceded by insertional inactivation of a marker gene coding for a chormogenic substrate. Give reasons.

Ans. Selection of recombinants due to inactivation of antibiotics is a laborious process as it requires:

(i) a vector with two antibiotic resistance marker

(ii) preparation of two kinds of media plate, with one antibiotic each.

Transformed cells are first plated on that antibiotic plate which has not been insertionally inactivated (ampicillin) and incubated overnight for growth of transformants. For selection of recombinants, these transformants are Replica plated on second antibiotic (tetracycline) plate (which got inactivated due to insertion of gene). Non-Recombinants grow on both the plates (one carrying ampicillin and the other carrying tetracycline) while recombinants will grow only on ampicillin plate.

This entire exercise is laborious and takes more time (two overnight incubation) as well. However, if we choose the second option (insertional inactivation of a marker that produces colour in the presence of a chromogenic compound), we can distinguish between the recombinants and non-recombinants on a single medium plate (containing one antibiotic and the chromogenic compound) after overnight growth.
Hence would choose a marker which produces a coloured compound but gets inactivated due to insertion of foreign DNA.

18. Describe the role of *Agrobacterium tumefaciens* in transforming a plant cell.

Ans. *Agrobacterium tumefaciens* harbours a mega plasmid called Ti-plasmid. This has a T-DNA region flanked by left border and right border sequence. The T-DNA gets transferred and integrates with the host plant DNA. This property of Ti-plasmid has been exploited for cloning of gene of interest and stably integrating them in the plant genese. Therefore, by using Ti-plasmid or its derivatives, recombinant plant cells with desired genes of interest stably integrated in the plant genome has been successfully produced.

19. Define transgenic animals. Explain in detail any four areas where they can be utilised.

Ans. Transgenic animals are products of genetic engineering and express specific gene(s) from totally unrelated source. Following are the four main areas where they can be utilised.

1. To study normal physiology and development these animals can be used to study as to which factor / gene products are needed at what time of development. By expression of certain genes, they help scientists to understand the normal gene expression at various stages of growth and development.
2. Study of Diseases

   Transgenic animals can be created to serve as models for various human diseases. They also help us understand the involvement of various genes in diseases like cancer, Parkinson' disease etc.
3. Vaccine safety

   Transgenic animals can be used to test vaccines like polio vaccine. Transgenic mice have shown promising results in this area and would replace the vaccine testing on monkeys in the years to come.
4. Chemical safety testing

   Transgenic animals are created which are more sensitive to certain chemicals / drugs. These are used to study the toxicity or side effects of that chemical / drug. The advantage is that we get results faster.

3. You have identified a useful gene in a bacteria. Make a flow chart of the steps that you would follow to transfer this gene to a plant.

Ans. After identifying a useful gene in bacteria, following steps should be undertaken

1. Isolation of useful gene using

   Restriction Endonucleases

   ↓
2. Transferring the gene to a suitable vector to create a recombinant DNA molecule

   ↓
3. Transfer of these recombinant DNA molecules to the target cells

   ↓
4. Screening of cells for transformation

   ↓
5. Selection of transformed cells

   ↓
6. Regeneration of plants from the transformed cells to get transgenic plants.

20. List the disadvantages of insulin obtained from the pancreas of slaughtered cows and pigs:

Ans. 1. Insulin being a hormone is produced in very little amounts in the body. Hence, a large number of animals need to be sacrificed for obtaining small quantities of insulin. This makes the cost of insulin very high. [Demand being many fold higher than supply].

2. Slaughtering of animals is also not ethical.
3. There is potential of immune response in humans against the administered insulin which is derived from animals.
4. There is possibility of slaughtered animals being infested with some infectious micro organism which may contaminate insulin.

21. What do you understand by the term bio-pesticide? Name and explain the mode of action of a popular bio-pesticide.

Ans. Biopesticide is a pesticide which is

a. not chemical in nature
b. more specific in action against the pest
c. safer for environment than chemical pesticides

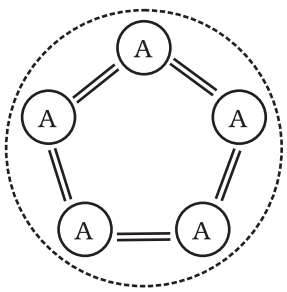
A popularly known bio-pesticide is Bt toxin, which is produced by a bacterium called *Bacillus thuringiensis*. Bt toxin gene has been cloned from this bacterium and expressed in plants. Bt toxin protein when ingested by the insect, gets converted to its active form due to the alkaline pH of the gut. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually kills the insect.

22. Name the five key tools for accomplishing the tasks of recombinant DNA technology. Also mention the functions of each tool.

Ans.
i. Restriction endonucleases: for cutting the desired DNA at desired places
ii. Gel electrophoresis: for separating the desired DNA fragments
iii. Ligase enzyme: for creating recombinant DNA molecule.
iv. DNA delivery system: like electroporation, microinjection, gene gun method.
v. Competant host (usually bacteria / yeast): to take up recombinant DNA.

23. Comment on the following diagrams:

A, B, C. D, G, P, Q, R, S are species



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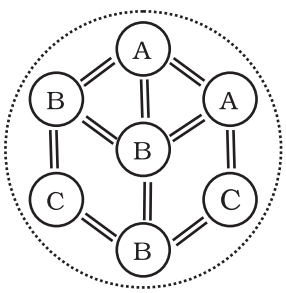

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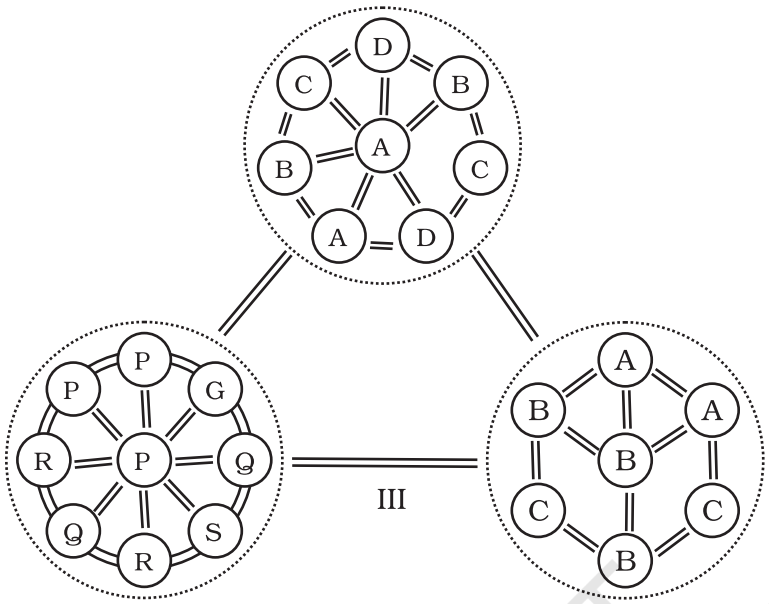

Ans.

Fig. I: It is a single population and all individuals are of the same species i.e. A. Individual interact among themselves and their environment.

Fig. II: It is a community and it contains three populations of species A,B and C. They interact with each other and their environment.

Fig. III: It is a biome. It contains three communities. of which one is in climax and other two are in different stages of development. All three communities are in the same environment and they interact with each other and their environment.

24. The following diagrams are the age pyramids of different populations. Comment on the status of these populations.

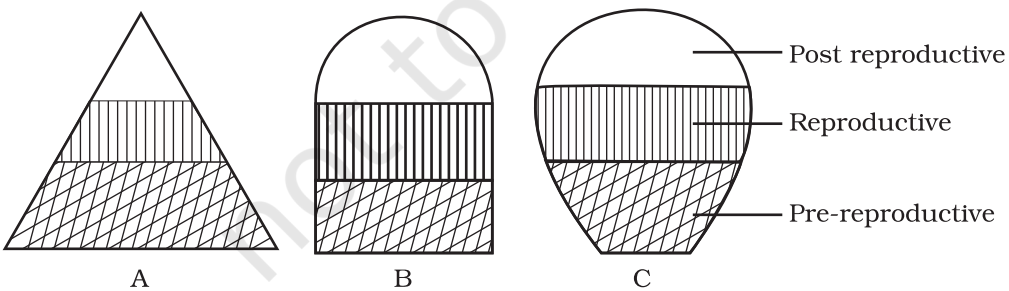

Fig.A: It is a pyramid shaped age pyramid. In this figure, the base i.e pre-reproductive stage is very large when compared with the reproductive and past reproductive stages of the population. This type of age structure indicates that the population would increase rapidly.

Fig.B: It is an inverted bell shaped pyramid. In this figure, the pre-reproductive and reproductive stages are same. This type of age structure indicates that the population is stable.

Fig.C: It is 'Urn' shaped pyramid. In this figure, the pre-reproductive and reproductive stages are less than the post reproductive stage of this population. In this population more older people are present. This type of age structure indicates that the population definitely is declining.

25. In an aquarium two herbivorous species of fish are living together and feeding on phytoplanktons. As per the Gausses principle, one of the species is to be eliminated in due course of time, but both are surviving. How? And what possibly happened to both the species?

Ans. Each species has a specific position or functional role within the community, called niche. According to the Gausses principle, no two species can live in the same niche. In this case, two herbivorous species are living in the same niche and feeding on phytoplanktons. It may be because of the availability of sufficient phytoplanktons/and or less number of individuals of the fish species. of the two species might have occured. And though neither of the species have been eliminated, niche overlapping may effect the growth and development of individuals of the species.

26. What will happen to an ecosystem if

a. All producers are removed;
b. All organisms of herbivore level are eliminated; and
c. All top carnivore population is removed

Ans. (a) Reduction in primary productivity. No biomass available for consumption by higher trophic levels / heterotrophs

(b) Increase in primary productivity and biomass of producers.

Carnivores population will subsequently dwindle due to food shortage.

(c) Increase in number of herbivores

Overgrazing by herbivores

Desertification

27. Elaborate how invasion by an alien species reduces the species diversity of an area.

Ans. Some possible explanations are that the alien species may be

i. Vigorously growing and compete with the natural plants for minerals, water etc. The less vigorous local species may be eliminated.
ii. Natural pests and predators of the alien species may not be present in the introduced area-leading to proliferation in their number.

iii. The introduced species may harm the local species by production of chemicals (Amensalism)

iv. The alien species by proliferation may make conditions unfavourable for the growth of local native plants. (eg. *Eichornia*)

28. How can you, as an individual, prevent the loss of biodiversity?

Ans. The loss of biodiversity can be prevented by

i. Practise of recycling waste paper etc.

ii. Judicious exploitation of medicinal and commercial plants and animals.

iii. Generating awareness among the public on the importance of biodiversity, conversation through skits, screening of films, lectures etc.

Teaching people how to reduce green house gases emissions, through alternate eco friendly green technologies like use of solar energy, wind energy, biogas, vermi compost, organic farming etc.

29. Write a short note on electronic waste. List the various sources of e- wastes and the problems associated with the disposal of e-waste.

Ans. Discarded unusable electronic gadgets such as computers, mobile phones, circuits, television sets, etc., form electronic waste. These contain harmful toxic substances like heavy metals to which the unskilled manual workers are directly exposed.

30. What are the basic characteristics of a modern land fill sites. List any three and mention the reasons for their use.

Ans. Characteristics of a modern land fill include

i. Methods to contain leachate such as lining clay or plastic liners.

iii. Compaction and covering of the waste to prevent it being blown by wind.

iv. Installation of a land fill gas extraction system to extract the gas for use in generation of power.