



**RJ VISION PVT. LTD.**  
(MOST STABLE & INNOVATIVE INSTITUTE)

**GSEB**  
**BPT – 5 B**

**BIOLOGY**  
**TEST**

**COURSE NAME: 12<sup>TH</sup>**

**Marks : 100 marks**

**Topic : FULL SYLLABUS**

**DATE :**

**PART – A**

**Instructions:**

- (1) There are 50 objective type (**M.C.Q**) questions in **part-A** and all questions are compulsory.
- (2) The questions are serially numbered from 1 to 50 and each carries 1 mark.
- (3) Read each question carefully, select proper alternative and answer in the O.M.R. sheet.
- (4) The OMR sheet is given for answering the questions. The answer of each question is represented by (1) O, (2) O, (3) O, (4)O. Darken the circle of the correct answer with ball-pen.
- (5) Rough work is to be done in the space provided for this purpose in the test booklet only.
- (6) Set No. of question paper printed on the upper-most right side of the Question paper is to be written in the column provided in the OMR sheet.

**PART-A**

1. Tropics (23.5° N to 23.5° s) have \_\_\_\_\_ species as compared to temperate or polar regions.  
(1) less (2) equal (3\*) more (4) none of these
2. One turn of the helix in a B-form DNA is approximately  
(1\*) 3.4 nm (2) 0.34 nm (3) 2 nm (4) 20 nm
3. Test cross involves:-  
(1) Crossing between two genotypes with recessive trait  
(2) Crossing between two F<sub>1</sub> hybrids  
(3\*) Crossing the F<sub>1</sub> hybrid with a double recessive genotype  
(4) Crossing between two genotypes with dominant trait
4. Which one of the following pairs is wrongly matched?  
(1\*) Coliforms – Vinegar  
(2) Methanogens – Gobar gas  
(3) Yeast – Ethanol  
(4) Streptomyces – Antibiotic
5. Restriction endonuclease-  
(1\*) Cuts the DNA molecule at specific sites  
(2) Synthesizes DNA  
(3) Restricts the synthesis of DNA inside the nucleus  
(4) Cuts the DNA molecule randomly
6. Amino acid sequences, in protein synthesis is decided by the sequence of  
(1) tRNA (2\*) mRNA (3) cDNA (4) rRNA

7. Some of the characteristics of Bt cotton are:  
 (1\*) High yield and resistance to bollworms  
 (2) Long fibre and resistance to aphids  
 (3) Medium yield, long fibre and resistance to beetle pests  
 (4) High yield and production of toxic protein crystals which kill dipteran pests
8. Vertical distribution of different species occupying different levels in dense vegetation is called  
 (1\*) stratification (2) species composition  
 (3) standing crop (4) trophic structure
9. Which one of the following is considered important in the development of seed habit?  
 (1) Free-living gametophyte (2) Dependent sporophyte  
 (3\*) Heterospory (4) Haplontic life cycle
10. What would be the number of chromosomes in the cells of the aleurone layer in a plant species with 8 chromosomes in its synergids?  
 (1) 16 (2\*) 24 (3) 32 (4) 8
11. Which enzyme is crucial for proper functioning of the immune system?  
 (1\*) Adenosine deaminase (2) Restriction endonuclease  
 (3) Ligase (4) Maltase
12. Percentage of individuals in successive age of given population is called  
 (1\*) age distribution (2) age density (3) age graph (4) age curve.
13. Which one of the following is not used as bio-fertiliser?  
 (1\*) Bacillus thuringiensis (2) Anabaena (3) Nostoc (4) Rhizobium
14. In an age pyramid, the number of individuals of reproductive age is lesser than pre-reproductive but higher than post reproductive ones. The population is  
 (1\*) Growing (2) Declining  
 (3) Stable (4) Cannot be predicted
15. A wasp pollinating a fig flower is an example of  
 (1) Commensalism (2) Amensalism (3) Parasitism (4\*) Mutualism
16. Microbes present in hydrothermal vents where the temperature far exceed 100°C is  
 (1) Cyanobacteria (2\*) Archaeobacteria  
 (3) Eubacteria (4) None of these
17. Method for analyzing inheritance pattern of traits in human being is:  
 (1) DNA finger printing (2) Control cross  
 (3\*) Pedigree analysis (4) All of the above
18. Which one of the following has the highest number of species in nature?  
 (1) Angiosperms (2) Fungi (3\*) Insects (4) Birds
19. Which of the following defines Hardy-Weinberg's law?  
 (1)  $p^2 + 2pq + q^2 = 0$  (2)  $q^2 + p^2 + 2pq = 0$   
 (3\*)  $p^2 + 2pq + q^2 = 1$  (4)  $p^2 + 3pq + q^2 = 1$
20. A threatened species category includes  
 (1) Only endangered species (2) Only vulnerable species  
 (3) Endangered and rare species (4\*) Endangered, vulnerable and rare species
21. Where was "Saheli" developed?  
 (1) Indian Council of Medical Research, New Delhi (2\*) Central Drug Research Institute, Lucknow  
 (3) All Indian Institute of Medical Sciences, New Delhi (4) None

22. "Test tube" baby refers to-
- (1) A baby born in test tube
  - (2\*) An ovum made to fertilise in-vitro and then implanted in the uterus
  - (3) A method of tissue culture
  - (4) None of these
23. Pills, implants and IUDs are very effective if taken within \_\_\_\_\_ of coitus.
- (1) 5 days
  - (2\*) 72 hours
  - (3) 30 days
  - (4) 15 days
24. Sterilisation in males is \_\_\_\_\_ and in females is \_\_\_\_\_.
- (1\*) Vasectomy, Tubectomy
  - (2) Tubectomy, Vasectomy
  - (3) Vasectomy, Vasectomy
  - (4) Tubectomy, Tubectomy
25. Substitution of a purine nucleotide by pyrimidine nucleotide is called
- (1) Transition
  - (2\*) Transversion
  - (3) Inversion
  - (4) Transduction
26. Trisomy has a chromosome complement of-
- (1)  $2n - 1$
  - (2)  $2n + 2$
  - (3)  $2n + 3$
  - (4\*)  $2n + 1$
27. Wheat variety Atlas 66 is rich in
- (1) Lipid content
  - (2) Water content
  - (3\*) Protein content
  - (4) Mineral content
28. Which one of the following pairs is correctly matched
- (1) Ribosomal RNA-carries aminoacids to the site of protein synthesis
  - (2) Transcription-process by which protein is synthesized
  - (3) Translation-process by which carries the information from nucleus to the ribosome
  - (4\*) Anticodon-site of tRNA molecule that contains complementary bases to the triple code on the RNA
29. Which of the following pyrimidine base is common in both DNA and RNA.
- (1) Adenine
  - (2) Guanine
  - (3\*) Cytosine
  - (4) Thymine
30. Which of the following feature of RNA 'make it labile and easily degradable'?
- (1) Single stranded nature
  - (2\*) 2'-OH group on sugar
  - (3) Phosphodiester bond
  - (4) Absence of Hydrogen bond
31. Which of the following is produced by genetically engineered bacterium?
- (1) Tyrosine
  - (2\*) Insulin
  - (3) Glycogen
  - (4) ADH
32. The method of DNA fingerprinting involves the use of:
- (1) Restriction enzyme
  - (2) Taq polymerase
  - (3) Oligonucleotide primers
  - (4\*) All of these
33. Rain-soaked forest occurs in which state of India?
- (1) Assam
  - (2\*) Meghalaya
  - (3) Arunachal Pradesh
  - (4) Nagaland
34. Identify the palindromic sequence in the following.
- (1)  $\frac{GAATC}{CTTUUG}$
  - (2\*)  $\frac{GGATCC}{CCTAGG}$
  - (3)  $\frac{CCTGG}{GGACC}$
  - (4)  $\frac{CGATA}{GCTAA}$
35. Which of the following is the bacterial disease in humans?
- (1) Pneumonia
  - (2) Malaria
  - (3) Plague
  - (4\*) Both (1) and (3)
36. The theory of natural selection was given by
- (1) Lamarck
  - (2) Alfred Wallace
  - (3\*) Charles Darwin
  - (4) Oparin and Haldane

37. Synthesis of DNA from RNA is explained by  
 (1) central dogma reverse (2) reverse transcription  
 (3) teminism (4\*) all of these.
38. Species richness of tropics is because of:  
 (1) Tropics have more evolutionary time (2) Tropics have relatively constant environment  
 (3) Tropics receive more solar energy (4\*) All of the above
39. At present, how many biosphere reserves does India have?  
 (1) 11 (2\*) 14 (3) 17 (4) 20
40. Identify the type/level of biodiversity from the following:  
 (1) Genetic (2) Species (3) Ecological (4\*) All of the above
41. In a monohybrid cross between two heterozygous individuals percentage of pure homozygous individuals obtained in F<sub>1</sub> generation will be  
 (1) 25% (2\*) 50% (3) 75% (4) 100%
42. A gene showing co-dominance has  
 (1) One allele dominant over the other  
 (2) Alleles tightly linked on the same chromosome  
 (3) Allele that are recessive to each other  
 (4\*) Both the alleles independently expressed in the heterozygote
43. The most common biofertilizer for rice crop is  
 (1) Sesbanearosteata (2\*) Azolla (3) Bacillus polymer (4) Trifolium
44. Which protein protects against viral infections:  
 (1) Immunoglobulin (2\*) Interferon (3) Myosin (4) Actin
45. Which of the following sets of diseases is caused by bacteria:  
 (1) Tetanus and mumps (2\*) Cholera and tetanus (3) Typhoid and small pox (4) Herpes and influenza
46. Attractants and rewards are required for:  
 (1) Anaemophilly (2\*) Entomophilly (3) Hydrophyll (4) Cleistogamy
47. If mammalian ovum fails to get fertilized, which one of the following is unlikely?  
 (1) Primary follicle starts developing (2\*) Estrogen secretion further declines  
 (3) Progesterone secretion rapidly declines (4) Corpus luteum will disintegrate
48. Which of the following is affected by the infection of Wuchereria bancrofti?  
 (1\*) Lymphatic vessels (2) Respiratory system (3) Nervous system (4) Blood circulation
49. To get pollinated by bee, the Mediterreanean orchid, ophrys employs  
 (1) Pseudo-copulation (2) Place for laying eggs  
 (3\*) Sexual deficit (4) Reward in the form of nectar
50. A lady is diagnosed to have both her fallopian tubes blocked. Which ART can help her to conceive a child?  
 (1) GIFT (2) ZIFT (3\*) IVF (4) SUZI

**PART- B**

**Instructions:**

- (1) Write in a clear legible handwriting.
- (2) There are three sections in part- B of the question paper and total 1 to 27 questions are there.
- (3) All the questions are compulsory. Internal options are given.
- (4) The numbers at right side represent the marks of the question.
- (5) Start new section on new page.
- (6) Maintain sequence.

**SECTION – A [2 M]**

**Answer question No. 1 to 12 as directed. Each question carry 2 marks. (Attempt any 8 out of 12)**

**[16]**

**1. Describe the structure of nucleosome.**

- Sol.** (a) The negatively charged DNA molecule wraps around the positively charged histone proteins to form a structure called nucleosome.  
(b) The nucleosome core is made up of four types of histone proteins—H2A, H2B, H3 and H4 occurring in pairs.  
(c) 200 bp of DNA helix wrap around the nucleosome by  $1\frac{3}{4}$  turns, plugged by H1 histone protein.

**2. Explain the roles of the following in biotechnology.**

- (a) Gel Electrophoresis  
(b) Selectable markers in pBR322

- Sol.** (a) Gel Electrophoresis: Separation of DNA fragments under the influence of electric field.  
(b) Selectable markers in pBR322: Helps in identifying and eliminating non-transformants from transformants or helps in selection of transformants.

**3. Explain the significance of palindromic nucleotide sequence in the formation of recombinant DNA.**

- Sol.** Palindromic nucleotide sequence is the recognition (specific) sequence present both on the vector and on a desired or alien DNA for the action of the same (specific) restriction endonuclease to act upon.

**4. Describe the post-fertilisation changes in a flower.**

- Sol.** The post-fertilization changes that take place in a flower are as follows:  
(i) The formation of zygote (inside ovule) which later develops into an embryo and primary endosperm cell which develops into endosperm (provide nourishment to the growing embryo).  
(ii) While the sepals, petals and stamens are shed, the pistil remain intact.  
(iii) The fertilized ovule develops into seeds.  
(iv) The ovary matures into a fruit that later develops a thick, protective wall called pericarp.  
(v) Seeds after dispersal germinate under favourable conditions which later develops into a new plant.

**5. Which property of DNA double helix led Watson and Crick to hypothesize semi-conservative mode of DNA replication? Explain.**

- Sol.** The two strands of DNA have complementary base pairing which run in opposite direction. This property of DNA led Watson and Crick to suggest semi conservative mechanism of DNA replication in which, one strand of parent is conserved while the other complementary is formed, a new.

**6. Mention the role of ribosomes in peptide bond formation How does ATP facilitate it?**

- Sol.** There are two sites in the large subunit of the ribosome, for subsequent amino acids to bind to and thus, be close enough to each other for the formation of a peptide bond. The ribosomes also acts as a catalyst for the formation of peptide bond 23S rRNA in bacteria is a ribozyme. Amino acids become activated by binding with its aminoacyl-tRNA synthetase in the presence of ATP.

**7. What are the application and future challenges of HGP?**

- Sol.** Deriving meaningful knowledge from the DNA sequences will define research through the coming decades leading to our understanding of biological systems. This enormous task will require the expertise and creativity of tens of thousands of scientists from varied disciplines in both the public and private sectors worldwide. One of the greatest impacts of having the HG sequence may well be enabling a radically new approach to biological research. In the past, researchers studied one or a few genes at a time. With whole genome sequences and new high throughput technologies, we can approach questions systematically and on a much broader scale. They can study all the genes in a genome for example, all the transcripts in a particular tissue or organ or tumor or now tens of thousands of genes and proteins work together in interconnected networks to orchestrate the chemistry of life.

**8. Discuss surgical method of sterilisation.**

**Sol.** Surgical methods, also called sterilisation, are generally advised for the male/female partner as a terminal method to prevent any more pregnancies. Surgical intervention blocks gamete transport and thereby prevent conception. Sterilisation procedure in the male is called 'vasectomy' and that in the female, 'tubectomy'. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum whereas in tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina. These techniques are highly effective but their reversibility is very poor.

**9. Write a short note on phenylketonuria.**

**Sol. Phenylketonuria:** This inborn error of metabolism is also inherited as the autosomal recessive trait. The affected individual lacks an enzyme that converts the amino acid phenylalanine into tyrosine. As a result of this phenylalanine is accumulated and converted into phenylpyruvic acid and other derivatives. Accumulation of these in brain results in mental retardation. These are also excreted through urine because of its poor absorption by kidney.

**10. How does the transmission of each of the following diseases take place?**

- (a) Amoebiasis
- (b) Malaria
- (c) Ascariasis
- (d) Pneumonia

**Sol.** (a) **Amoebiasis.** By ingesting cysts of *Entamoeba histolytica* with water or food. The cysts are carried from faeces of patient to food and drinks.  
(b) **Malaria.** Malarial parasite (*Plasmodium sp.*) is transmitted from the infected to the healthy person by the female Anopheles mosquito.  
(c) **Ascariasis.** By ingesting Ascaris eggs with food and water. Children become infected by ingesting soil.  
(d) **Pneumonia.** By the sputum and droplets released during coughing of the patient.

**11. How do mycorrhizae help the plants to grow better?**

**Sol.** Mycorrhizae absorb phosphorus, provide resistance to root-borne pathogens and enhance the tolerance of the plants towards salinity and drought.

**12. A bacterial cell was transformed with a recombinant DNA that was generated using a human gene. However, the transformed cells did not produce the desired protein. What could be the possible reason?**

**Sol.** The process of making a recombinant DNA molecule involves the introduction of a desired gene into the DNA of a host that will produce the desired protein.  
Introducing a cloned eukaryotic gene or function in prokaryotic host can be difficult.  
The presence of long non-coding introns in eukaryotic genes may prevent the correct expression of these genes in prokaryotes, which lack RNA-splicing machinery

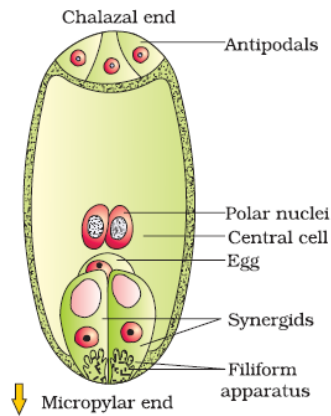
**SECTION – B [3 M]**

**Answer question No.13 to 21 as directed. Each question carry 3 marks. (Attempt any 6 out of 9) [18]**

**13.** With a neat diagram explain the 7-celled, 8-nucleate nature of the female gametophyte.

**Sol.**

- ❖ In a majority of flowering plants, one of the megaspores is functional while the other three degenerate. Only the functional megaspore develops into the female gametophyte (embryo sac). This method of embryo sac formation from a single megaspore is termed monosporic development.
- ❖ The nucleus of the functional megaspore divides mitotically to form two nuclei which move to the opposite poles, forming the 2-nucleate embryo sac. Two more sequential mitotic nuclear divisions result in the formation of the 4-nucleate and later the 8-nucleate stages of the embryo sac.



- (i) **Egg apparatus:** It consists of two synergids and an egg cell towards the micropylar end. The cells of egg apparatus are uninucleate. Synergids towards its micropylar end have cellular thickenings called filiform apparatus that helps in guiding pollen tube into the synergids.
- (ii) **Antipodal cells:** Chalazal end of embryo sac contain three cells of various shapes and sizes called antipodal cells.
- (iii) **Central cell:** It is single and largest cell which is bounded by a membrane of embryo sac. It contains two polar nuclei later fuse to form diploid secondary nucleus. After fertilisation the central cell gets converted into triploid primary endosperm cell (PEC) which forms endosperm.

**14. Name and explain the two types of immune responses in humans.**

**Sol.** The two types of immunity are active immunity and passive immunity.

Active immunity: Immunity developed in the host body due to production of antibodies in response to antigens.

Passive immunity: When ready-made antibodies are directly given to protect the body against foreign agents.

**OR**

The two types of immunity are humoral immunity and cell-mediated immunity.

Humoral immunity: Immune response given by antibodies found in the blood.

Cell-mediated immunity: T-lymphocytes mediate this immunity.

**OR**

The two types of immunity are primary immunity and secondary immunity.

Primary immunity: When our body encounters a pathogen for the first time produces primary response.

Secondary immunity: Subsequent encounter with the same pathogen generates highly intensified secondary response.

**15. How do homologous organs represent divergent evolution? Explain with the help of a suitable example.**

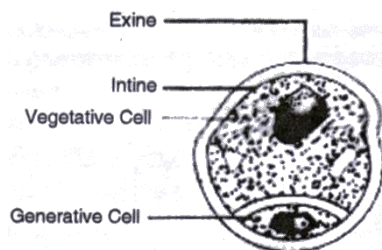
**Sol.** The organs with same structural design and origin but different functions are called homologous organs.

This is divergent evolution and these structures are homologous. Homology indicates common ancestry. Other examples are vertebrate hearts or brains.

In plants also the thorn and tendrils of Bougainvillea and cucurbita represent homology. Homology is based on divergent evolution where as analogy refers to a situation exactly opposite wings of butterfly and of birds look alike.

**16. Draw a labelled diagram of the sectional view of a mature pollen grain of angiosperms. Explain the function of generative cell and vegetative cell.**

**Sol. Functions:**



Vegetative Cell – It is bigger, has abundant food reserve.

Generative Cell – It divides mitotically to give rise to two male gametes.

**17. Write an explanatory note on In situ conservation.**

**Sol.** In situ (on site) conservation is the conservation and protection of the whole ecosystem and its biodiversity at all levels in order to protect the threatened species. However, it is not economically feasible to conserve all the biological wealth at all the existing ecosystem.

**Methods used in in situ conservation are:**

**Biodiversity hotspots:** Biodiversity hot spots is an approach for in situ method of conservation. Eminent conservationists have identified certain regions for the maximum protection these regions are called biodiversity hotspots. These are regions with very high levels of species richness, high degree of endemism (species confined to a region and not found anywhere else) and accelerated habitat loss. Initially 25 biodiversity hotspots were identified. Now there are 34 hotspots all over the world. Three hotspots are in India i.e., western Ghats and Sri Lanka, Indo-Burma and eastern Himalaya. If all the biodiversity hotspots are put together, they cover less than 2% of the earth's land area but harbour extremely high diversity. Ongoing mass extinction could be reduced by 30% through strict protection of these hot spots.

**Protected Areas:** Protected areas are especially dedicated areas for protection and maintenance of ecologically unique and biodiversity rich regions.

**18. Explain briefly**

- (a) PCR
- (b) Restriction enzymes and DNA
- (c) Chitinase

**Sol.** (a) PCR stands for polymerase chain reaction. in this reaction , multiple copies of the gene of interest are under three steps:

- (i) Denaturation : In this , double stranded DNA is converted to the single stranded often achieved by heating or alkaline conditions. This is called 'melting of DNA.
- (ii) Annealing. The two sets of primes (small chemical synthesized oligonucleotides that are complementary to the regions of DNA) undergo biochemical process of annealing at an optimum temperature of 40-65° C.
- (iii) Extension: The enzyme DNA polymerase extends the using the nucleotides provided in the reaction and the genomic DNA as template.

If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times. Such repeated amplification is achieved by the use a thermostable DNA polymerase and the amplified fragment if desired can be used to legate with a vector for further cloning.

- (b) Two enzymes responsible for restating the growth of bacteriophage in E.coli were isolated. One of these added methyl groups to DNA while the other cut DNA. The later was called restriction endonuclease. The restriction Endonuclease binds to the DNA cuts each of the two strands of the double helix .at specific points in their sugar-phosphate backbones.
- (c) During the isolation of DNA in process of recombinant DNA technology, the fungal call is heated with enzyme called chitinase. The chitinase enzyme dissolves the chitin membrane of the fungus to open the call for release of DNA along with other macromolecules such as RNA, proteins, polysaccharides and lipids.



**19. Write short note on “Theory of natural selection”.**

**Sol.** Natural selection is based on certain observations which are factual. (1) Natural resources are limited, populations are stable in size except for seasonal fluctuation, members of a population vary in characteristics even though they look superficially similar, most of variations are inherited etc. (2) Population size will grow exponentially if everybody reproduced maximally. (3) The population sizes in reality are limited, means that there had been competition for resources. (4) Only some survived and grew at the cost of others that could not flourish. (5) Variations, which are heritable and which make resources utilisation better for few will enable only those to reproduce and leave more progeny. (6) Over many generations, survivors will leave more progeny and there would be a change in population characteristic and hence new forms appear to arise.

**20. How HIV virus infect the human cell? How is HIV infection diagnosed?**

**Sol.** After getting into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase. This viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce virus particles. The macrophages continue to produce virus and in this way acts like a HIV factory. Simultaneously, HIV enters into helper T-lymphocytes ( $T_H$ ), replicates and produce progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person. During this period, the person suffers from bouts of fever, diarrhoea and weight loss. Due to decrease in the number of helper T lymphocytes, the person starts suffering from infections that could have been otherwise overcome such as those due to bacteria especially *Mycobacterium*, viruses, fungi and even parasites like *Toxoplasma*. The patient becomes so immuno-deficient that he/she is unable to protect himself/herself against these infections. A widely used diagnostic test for AIDS is enzyme linked immuno-sorbent assay (ELISA).

**21. How are microbes useful in industrial production of enzymes and other bioactive molecules?**

**Sol.** Yeast (*Saccharomyces cerevisiae*) is used for commercial production of ethanol. Microbes are also used for production of enzymes. Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry. You must have noticed that bottled fruit juices bought from the market are clearer as compared to those made at home. This is because the bottled juices are clarified by the use of pectinases and proteases. Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack. Another bioactive molecule, cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*. Statins produced by the yeast *Monascus purpureus* have been commercialised as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

**SECTION – C [4 M]**

**Answer question No. 22 to 27 as directed. Each question carry 4 marks. (Attempt any 4 out of 6) [16]**

**22. Define decomposition and describe the processes and products and decomposition.**

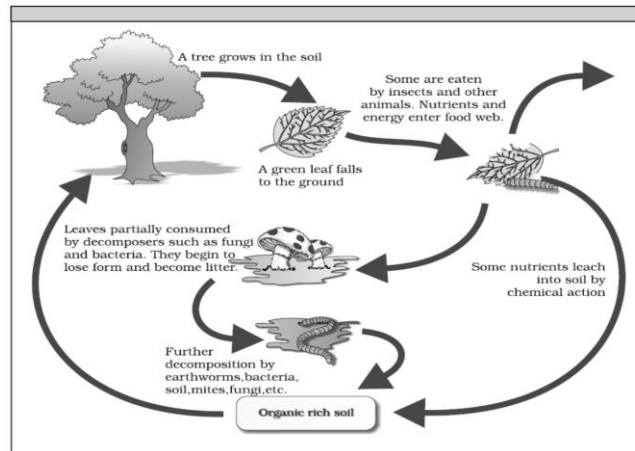
**Sol.** It is physical and chemical breakdown of complex organic remains with the help of organisms called decomposers. Processes and products. Three categories of processes operate simultaneously –fragmentation, catabolism and leaching.

**(1) Fragmentation.** It is carried out by detritivores (e.g earthworms termites) Detritivores break the detritus. Fine fragments are left out while the other ones are ingested. Their faecal matter also contains a lot of pulverized detritus.

**(2) Catabolism.** Saprotrophs decomposers (mostly bacteria and fungi) pour their digestive enzymes over the fragmented detritus. This cause breakdown and solubilisation of a number of organic substance some substance are

however, slow to be decomposed, e.g., lignin, cellulose .As a result detritus is converted into humus. The process is called **humification**. Humus degrades slowly and is ultimately decomposed completely. Decomposing of organic matter release inorganic substance. the process is known as mineralization. Inorganic substance become available for absorption and utilization by plants.

**(3) Leaching.** Soluble substance formed during decomposition pass into soil along with percolating water to be made available to roots of plants for absorption.



(Decomposition process)

23. A 17-year old boy is suffering from high fever with profuse sweating and chills. Choose the correct option from the following diseases which explains these symptoms and rule out the rest with adequate reasons.

- (a) Typhoid
- (b) Viral Fever
- (c) Malaria

Sol. (a) If the boy is suffering from typhoid, then he should have sustained high fever ( $39^{\circ}$  to  $40^{\circ}\text{C}$ ), weakness, stomach pain, constipation and headache. So he cannot be suffering from typhoid.  
 (b) If the boy is suffering from viral fever, then he will suffer from high fever, joint pain, weakness, and headache. So he cannot be suffering from viral fever.  
 (c) If the boy is suffering from malaria, then he should have high fever recurring with profuse sweating every three to four days associated with chills and headache. Therefore, there is a possibility that he is suffering from malaria.

24. (a) Explain the process of spermatogenesis in human male.  
 (b) What are the functions of Leydig cells and nurse cells?

Sol. (a) **Process of spermatogenesis:**

(i) **Multiplication phase:** The male germ cells (spermatogonia) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers.

(ii) **Growth phase:** Spermatogonia grow and increase in size and form primary spermatocytes. Each spermatogonium is diploid and contains 46 chromosomes.

(iii) **Maturation phase or formation of spermatids:** Some of the spermatogonia called primary spermatocytes periodically undergo meiosis. A primary spermatocyte completes the first meiotic division (reduction division) leading to formation of two equal haploid cells called secondary spermatocytes, which have only 23 chromosomes each. The secondary spermatocytes undergo the second meiotic division to produce four equal haploid spermatids.

(iv) **Differentiation phase:** The spermatids are transformed into spermatozoa (sperms) by the process of spermiogenesis. The sperm's head gets attached to Sertoli cells to draw nourishment and are finally released from the seminiferous tubules by the process called spermiation.

- (b) Functions of Leydig cells is to secrete testicular hormones called Androgens like testosterone.  
Nurse cells/Sertoli cells provide nutrition to germ cells.

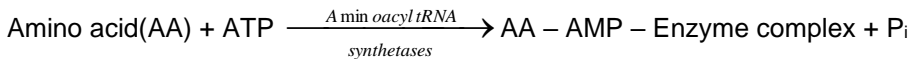
**25. Explain the process of translation.**

**Sol.** Translation is the process of synthesis of protein from mRNA with the help of ribosome.

A translational unit in mRNA from 5' → 3' comprises of a start codon, region coding for a polypeptide, a stop codon and untranslated regions (UTRs) at both 5'-end and 3'-end for efficient process.

**(a) Initiation:** In prokaryotes, initiation requires the large and small ribosome subunits, the mRNA, initiation tRNA and three initiation factors (IFs).

**Activation of amino acid:** Amino acids become activated by binding with aminoacyl tRNA synthetase enzyme in the presence of ATP.



**Transfer of amino acid to tRNA:** The AA-AMP-Enzyme complex reacts with specific tRNA to form aminoacyl-tRNA complex.



The cap region of mRNA binds to the smaller subunit of ribosome. The ribosome has two sites, A-site and P-site.

The smaller subunit first binds to the initiator mRNA and then binds to the larger subunit so that initiation codon (AUG) lies on the P-site.

The initiation tRNA, i.e., methionyl tRNA then binds to the P-site.

**(b) Elongation of polypeptide chain:** Another charged aminoacyl tRNA complex binds to the A-site of the ribosome at the second codon. A peptide bond is formed between carboxyl group (—COOH) of amino acid at P-site and amino group (—NH) of amino acid at A-site by the enzyme peptidyl transferase.

The ribosome slides over mRNA from codon to codon in the 5'→3' direction. According to the sequence of codons, amino acids are attached to one another by peptide bonds and a polypeptide chain is formed.

**(c) Termination of polypeptide:** When the A-site of ribosome reaches a termination codon which does not code for any amino acid, no charged tRNA binds to the A-site.

Dissociation of polypeptide chain from ribosome takes place, which is catalysed by a 'release factor'.

There are three termination codons namely UGA, UAG and UAA.

**26. Name and explain the models population growth.**

**Sol. (i) Exponential Growth**

- The exponential or geometric growth is common where the resources (food + space) are unlimited.
- Each species has the ability to realise fully its innate potential to grow in number.
- The equation for exponential growth can be derived as follows:

$$\frac{dN}{dt} = (b - d) \times N$$

Let (b - d) = r then

$$\frac{dN}{dt} = rN$$

Integral form of exponential growth equation is

$$N_t = N_0 e^{rt}$$

where, N = population size,

$N_t$  = population density after time t,

$N_0$  = population density at time zero,

r = intrinsic rate of natural increase,

e = the base of natural logarithms (2.71828),

b = birth rate (per capita births)

d = death rate (per capita death rates).

- 'r' is an important parameter assessing impacts of biotic and abiotic factors on population growth. 'r' for flour beetle was 0.12, for Norway rat was 0.015 and for human population in India was 0.0205 in 1981.
- In exponential growth, when N in relation to time is plotted on graph, the curve becomes J shaped.

### (ii) Logistic growth

- The resources become limited at certain point of time, so no population can grow exponentially.
- This growth model is more realistic.
- Every ecosystem or environment or habitat has limited resources to support a particular maximum number of individuals called its **carrying capacity (K)**.
- When N is plotted in relation to time t, the logistic growth show sigmoid curve and is also called **Verhulst–Pearl logistic growth**. It is given by the following equation:

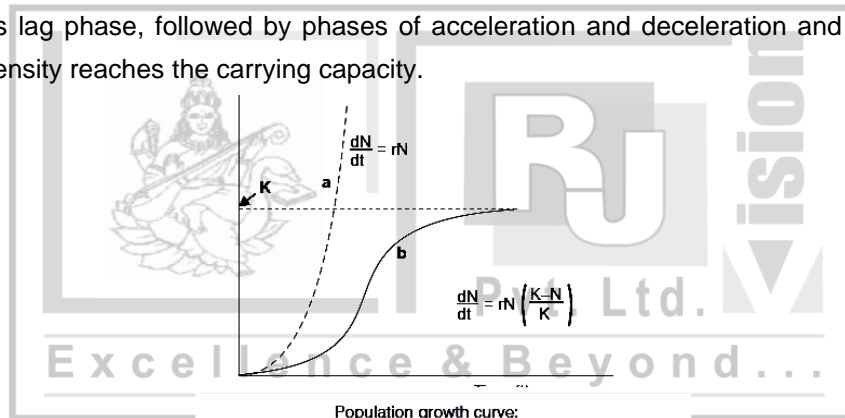
$$\frac{dN}{dt} = rN \left[ \frac{K - N}{K} \right]$$

where N = population density at time t

r = intrinsic rate of natural increase

K = carrying capacity.

- Graph shows lag phase, followed by phases of acceleration and deceleration and finally an asymptote when population density reaches the carrying capacity.



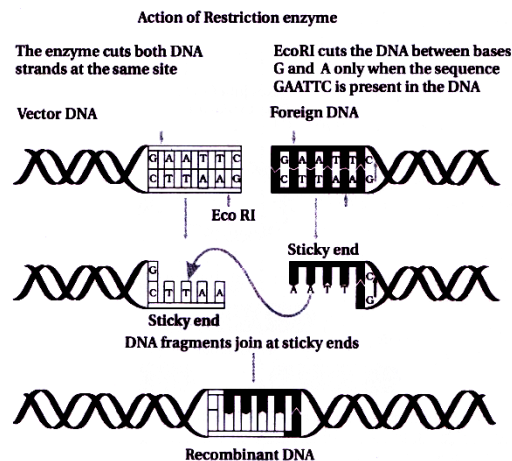
Population growth curve:  
(a) When resources are not limiting the growth, plot is exponential.  
(b) When resources are limiting the growth, plot is logistic, K is carrying capacity.

### 27. Give types and functions of nuclease enzyme.

**Sol.** Restriction enzymes belong to a larger class of enzymes called nucleases.

(i) Exonuclease enzymes: they remove nucleotides from the ends of the DNA.

(ii) Exonuclease: Endonucleases make cuts at specific positions within the DNA.



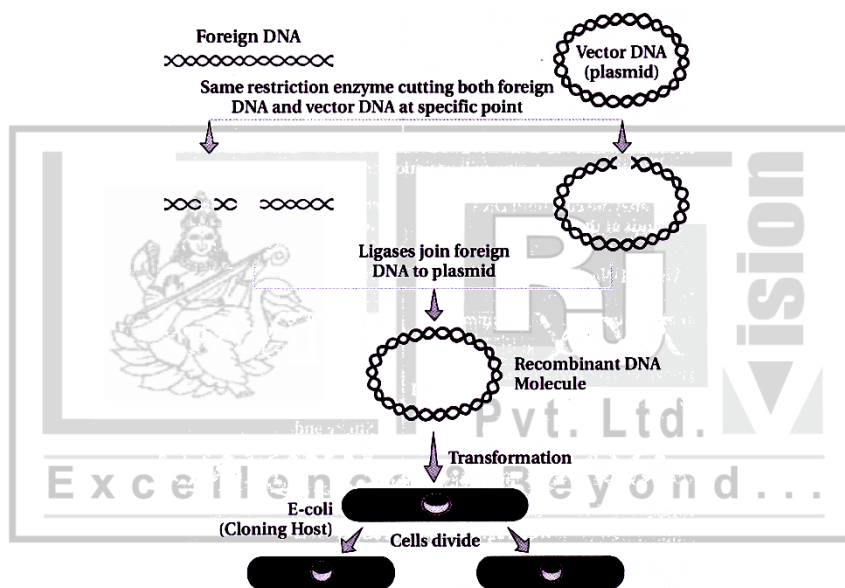
Steps in formation of recombinant DNA by action of restriction endonuclease enzyme - EcoRI

Each restriction endonuclease functions by inspecting the length of a DNA sequence. Once it finds the specific recognition sequence it will bind to the DNA. And cut each of the two strands of the double helix at specific points in their sugar phosphate backbones. Each restriction endonuclease recognise a specific palindromic nucleotide sequence in the DNA. The palindrome in DNA is a sequence of base pairs that reads same on the two strands when orientation of reading is kept the same. E.g. the following sequences reads the same on the two strands in 5' → 3' direction. This is also true if read in the 3' → 5' direction.

5' ————— GAATTC ————— 3'  
 3' ————— CTTAAG ————— 5'

When restriction endonuclease work on Polyandrome then it cuts both sequences of DNA molecule. Some enzymes cut two strands symmetrically and make blunt ends while other enzymes cut the strands asymmetrically and make sticky ends.

In recombinant – DNA technology such enzymes are used which cut DNA and make sticky ends. While plasmids and desired/Foreign DNA, both are cut by same enzyme, the resultant DFNA fragments have the same kind of sticky ends. Such cut fragments of DNA can be joined together by use of DNA ligase enzyme. Unless one cuts the vector and source DNA with the same restriction enzyme, the recombinant vector molecule cannot be created.



Diagrammatic representation of recombinant DNA technology