

PRACTICE PAPER **3***

Time allowed : 2 hours

Maximum marks : 35

General Instructions :

- (i) All questions are compulsory.
- (ii) The question paper has four sections: Section A, Section B, Section C and Section D. There are 15 questions in the question paper.
- (iii) Section-A has 06 questions of 1 mark each and 01 case-based question. Section-B has 4 questions of 2 marks each. Section-C has 2 questions of 3 marks each and Section-D has 2 questions of 5 marks each.
- (iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
- (v) Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION - A

1. Which of the three forests- Temperate, Mangroves and Tropical Evergreen is more vulnerable to invasion by outside animals and plants?
2. Differentiate between genetic and species diversity.
3. Who is mainly responsible for the 'Sixth Extinction'?
4. Why do DNA fragments move towards the anode during gel electrophoresis?
5. **Assertion :** Proto-oncogenes are cellular genes required for normal growth.
Reason : Under normal conditions they could lead to the oncogenic transformation of the cell.
 - (a) Both assertion and reason are true, and reason is the correct explanation of assertion.
 - (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
 - (c) Assertion is true but reason is false.
 - (d) Assertion is false but reason is true.
6. **Assertion :** In ripening of cheese, insoluble proteins are cleaved to form soluble peptides.
Reason : Hard cheese and soft cheese, both are ripened by lactic acid bacteria.
 - (a) Both assertion and reason are true, and reason is the correct explanation of assertion.
 - (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
 - (c) Assertion is true but reason is false.
 - (d) Assertion is false but reason is true.

OR

Assertion : *Rhizobium* forms nodules on the roots of legume plants.

Reason : *Rhizobium* fixes atmospheric nitrogen into organic forms which is used by the plant as nutrients.

- (a) Both assertion and reason are true, and reason is the correct explanation of assertion.
 - (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
 - (c) Assertion is true but reason is false.
 - (d) Assertion is false but reason is true.
7. **Read the following and answer questions from 7(i) to 7(v) given below:**
Disposal of untreated sewage into the river or freshwater pond causes huge water pollution. Four water samples from different sources (A, B, C, D) are collected and tested for BOD value in a lab to assess their quality. The BOD values are presented in the given table. Water samples are collected from primary effluent, secondary effluent, untreated sewage and river water. Study the given table and answer the following.

Sample	BOD
A	20 mg/L
B	5 mg/L
C	300 mg/L
D	400 mg/L

- (i) The source of sample 'C' is
 (a) river water (b) primary effluent
 (c) secondary effluent (d) untreated sewage water.
- (ii) If sewage in untreated condition is disposed off in a freshwater body then
 (a) BOD and dissolved oxygen both will increase
 (b) BOD will increase and dissolved oxygen will decrease
 (c) BOD will decrease and dissolved oxygen will increase
 (d) BOD and dissolved oxygen both will decrease.
- (iii) A large number of pathogenic microbes can be present in water sample of
 (a) C (b) A
 (c) D (d) both (a) and (c).
- (iv) High value of BOD in sample D is due to
 (a) high amount of organic wastes and aerobic microbes
 (b) high amount of inorganic wastes and anaerobic microbes
 (c) high amount of organic wastes and anaerobic microbes
 (d) high amount of inorganic wastes and aerobic microbes.
- (v) River water is represented by the sample
 (a) A (b) B (c) C (d) D.

SECTION - B

8. Mention any four important advantages of biogas generation.
9. (a) Define the term 'health'. When is "World Health Day" celebrated?
 (b) Describe the factors which affect our health.
10. (a) Name the key tools used in recombinant DNA technology.
 (b) What do you mean by restriction digestion?
11. Differentiate between commensalism and mutualism by taking one example each from plants only.

OR

Define interference competition. Give one example that supports competitive exclusion occurring in nature.

SECTION - C

12. (a) A farmer adds *Azotobacter* culture to the soil before sowing maize. How will it increase the yield of maize?
 (b) Explain the role of *Lactobacillus* in preparation of household products.
13. Who invented polymerase chain reaction (PCR)? Explain its working procedure.

OR

- (a) What are cloning vectors. What is their function?
 (b) State the role of DNA ligase in biotechnology.

SECTION - D

14. (a) Describe the characteristics a cloning vector must possess.
 (b) Why DNA cannot pass through the cell membrane? Explain. How is bacterial cell made 'competent' to take up recombinant DNA from the medium?

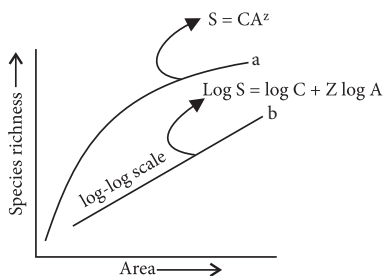
OR

- (a) Explain the important methods of gene transfer into the host cell without using a vector.
 (b) Diagrammatically show steps involved in silencing of specific mRNA in eukaryotes.
15. (a) List any three parameters used by ecologists under different situations to measure the population size in a habitat.
 (b) Mention what do the following stand for in the equation given below:
 (i) N_{t+1} (ii) B and (iii) E.

$$N_{t+1} = N_t + [(B + I) - (D + E)]$$
 Give an explanation for the above equation.

OR

(a) Explain the species-area relationship using the graphical representation given below.



(b) Explain giving reasons why there is greater biodiversity in tropical regions of the Earth.

ANSWERS

1. Tropical evergreen forest is more vulnerable to invasion by outside animals and plants.

2. The differences between genetic diversity and species diversity are as follows:

S.No.	Genetic diversity	Species diversity
(i)	It is related to number of genes and their alleles found in organisms.	It is related to number and distribution of species found in an area.
(ii)	It is trait of the species.	It is trait of the community.
(iii)	It influences adaptability and distribution of a species in diverse habitats.	It influences biotic interactions and stability of the community.

3. Human activities like settlements, hunting, over-exploitation and habitat destruction are mainly responsible for 'Sixth extinction'.

4. DNA is a negatively charged molecule and during gel electrophoresis, DNA fragments move towards anode (positive electrode) under the influence of electrical field.

5. (c): Proto-oncogenes are cellular genes required for normal growth. If they are muted or overexpressed, they may become oncogenes that contribute to the malignant transformation of the cell.

6. (c) : The ripening of cheese is a complex process. In the young cheese, all nitrogen is present in the form of insoluble proteins, but as ripening proceeds, the protein is progressively cleaved to soluble peptides. Hard cheeses are ripened largely by lactic acid bacteria, which grow throughout the cheese, die, autolyze and release hydrolytic enzymes. Soft cheeses are ripened by the enzymes from yeasts and other fungi that grow on the surface.

OR

(b) : *Rhizobium* forms nodules on the roots of legume plants. There are about a dozen species of *Rhizobium* which form association with different legume roots, e.g., *R. leguminosarum*, *R. lupini*, *R. trifolii*, *R. meliloti*, *R. phaseoli*. They develop the ability to fix nitrogen only when they are present inside the root nodules.

7. (i) (b) : A – Secondary effluent, B – River water, C – Primary effluent, D – Untreated sewage water

(ii) (b)

(iii) (d) : A number of pathogenic microbes mostly present in sewage water. They are removed during secondary or biological treatment. During primary treatment, small and large, floating and suspended solids are removed through filtration and sedimentation.

(iv) (a)

(v) (b)

8. The important advantages of biogas generation are given below:

(i) Biogas can be stored and used more efficiently and economically.

(ii) The energy value of biogas is lower than that of organic matter but due to more efficient handling, the net energy output is roughly equal to the output in direct burning of organic wastes.

(iii) The manure produced in biogas plants is used as fertiliser.

(iv) Biogas use does not add to pollution.

9. (a) Health does not mean "absence of disease or physical fitness". It may be defined as state of complete physical, mental and social well being and not only absence of disease.

World Health Day is celebrated on 7th April.

(b) Our health is affected by different factors such as:

(i) genetic disorders - deficiencies with which a child is born and deficiencies/defects which the child inherits from parents during birth;

(ii) infections and

(iii) life style including food and water we take, rest and exercise we give to our bodies, habits that we have or lack, etc.

10. (a) Restriction enzymes, polymerase enzymes, ligases, vectors and the host organisms.

(b) The process of cutting DNA by restriction enzymes is called restriction digestion.

11. The differences between mutualism and commensalism are as follows :

S.No.	Mutualism	Commensalism
(i)	It is an association between two organisms in which both are benefitted.	It is an association between two organisms in which only one is benefitted. The second is neither benefitted nor harmed.
(ii)	Contact between the two organism is obligatory.	Contact between commensal and its benefactor may be periodic or continuous.
(iii)	Nitrogen fixing blue-green alga or cyanobacterium called <i>Anabaena</i> is associated with water fern <i>Azolla</i> in a mutualistic interaction.	Many epiphytes, e.g., orchids, are found growing on the branches and in the forks of trees. These epiphytes use the trees only for attachment and manufacture their own food by photosynthesis.

OR

Interference competition is the feeding efficiency of one species which might be reduced due to the interfering and inhibitory presence of the other species, even if resources (food and space) are abundant. One of the example that support competitive exclusion occurring in nature is-

The Abingdon tortoise became extinct within a decade after goats were introduced on the island, apparently due to the greater browsing efficiency of the goats.

12. (a) Free-living nitrogen fixing bacteria fix atmospheric nitrogen in the soil and make it available for the higher plants. *Azotobacter* occurring in fields of cotton, maize, jowar and rice, not only increases yield but also saves about 10-25 kg/ha of nitrogen fertiliser.

(b) Microorganisms commonly called lactic acid bacteria (LAB), e.g., *Lactobacillus* are added to milk for production of curd. They convert lactose sugar of milk into lactic acid. Lactic acid causes coagulation and partial digestion of milk protein, casein, thereby changing milk into curd, yoghurt and cheese. The starter or inoculum used in preparation of milk products actually contains millions of LAB. In this way, *Lactobacillus* plays an important role in preparation of household products.

13. The polymerase chain reaction (PCR) was invented by Kary Mullis in 1985.

The working procedure of PCR is given as :

A single PCR amplification cycle involves three basic steps; denaturation, annealing and extension (polymerisation).

(i) Denaturation : In this step, the target DNA is heated to a high temperature (usually 94° to 96°C), resulting in the separation of the two strands. Each single strand of the target DNA then acts as a template for DNA synthesis.

(ii) Annealing : In this step, the two oligonucleotide primers hybridise to each of the single stranded template DNA since the sequence of the primers is complementary to the 3' ends of the template DNA. This step is carried out at a lower temperature (usually 40° to 60°C) depending on the length and sequence of the primers.

(iii) Extension : The final step is extension, wherein *Taq* DNA polymerase (obtained from *Thermus aquaticus*) synthesises the DNA region between the primers, using dNTPs (deoxynucleoside triphosphate) and Mg^{2+} . It means the primers are extended towards each other so that the DNA segment lying between the two primers is copied. The optimum temperature for this polymerisation step is 72°C.

OR

(a) Cloning vectors are those organisms or their DNAs which can multiply independently of the host DNA and increase their copy number along with the foreign DNA attached to them. Cloning vectors may be plasmids, bacteriophages, cosmids, viruses, etc.

Functions :

(i) They help in linking the foreign DNA with that of the host.

(ii) They also help in the selection of recombinants from the non-recombinants.

(b) DNA ligase joins two individual fragments of DNA by the formation of phosphodiester bond between them.

14. (a) A cloning vector must possess the following characteristics:

(i) Origin of replication (*Ori*) : *Ori* is a sequence from where replication starts and is also responsible for controlling the copy number of the linked DNA.

(ii) Selectable marker : Selectable markers help in selecting transformant host cell from non-transformant ones.

(iii) Cloning sites : A vector must have unique recognition site to link foreign DNA. Presence of a particular cloning/ recognition site enables the particular enzyme to cut the vector DNA.

(b) Competent host is essential for transformation with recombinant DNA. Since DNA is a hydrophilic molecule, it cannot pass through membranes, so the bacterial cells must be made capable to take up DNA i.e., made competent. This is done by treating them with a specific concentration of a divalent cations, such as calcium which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. Recombinant DNA (rDNA) can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42°C (heat shock), and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.

Other methods are:

(i) Microinjection : DNA is inserted through microneedles or micropipettes.

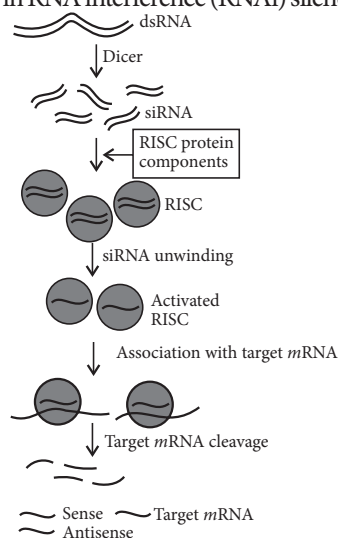
(ii) Electroporation : Electric impulse induce transient pores.

(iii) Gene gun or biolistic : DNA coated with microscopic pellets of gold or tungsten is shot with high velocity into target cells.

OR

(a) The direct or vectorless gene transfer involves following methods:

- (i) **Electroporation** : In this method, electrical impulses induce transient pores in the plasma membrane of host cell by using lysozyme or calcium chloride through which foreign DNA molecules are incorporated into cells.
- (ii) **Biolistic method or gene gun method** : Biolistic is a means of introducing DNA into cells that involves bombardment of cells with high-velocity microprojectiles coated with DNA. In this method tungsten or gold particles, coated with foreign DNA are bombarded into target cells at a very high velocity.
- (iii) **Micoinjection** : It is the introduction of foreign gene directly into nucleus of plant cell or animal cell by using microneedles or micropipettes.
- (iv) **Chemical mediated gene transfer**: In this method polyethylene glycol (PEG) help foreign DNA to enter the host cell.
- (b) The steps in RNA interference (RNAi) silencing of mRNA.



15. (a) **Population density** means number of individuals present per unit area or per unit volume of the environment in which the population exists. We can find out population density of a habitat by determining the population size.

The different methods to study population size are as follows:

- **Quadrat method** : It is a method which involves the use of square of particular dimension to measure number of organisms. For example the number of *Parthenium* plants in a given area can be measured using the quadrat method.
- **Direct observation**: It involves counting of organisms. For example, in order to determine the number of bacteria growing in a petri dish, their colonies are counted.
- **Indirect method** : The number of fishes caught per trap gives the measure of their total density in a given water body.

(b) In the given equation,

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

- (i) N_{t+1} refers to population density at time $t + 1$

(ii) B represents natality or number of births

(iii) E represents number of emigrants.

From the above equation it is clear that population density increases if the number of births plus the number of immigrants (B + I) is more than the number of deaths plus the number of emigrants (D + E). Otherwise it will decrease.

OR

(a) Alexander von Humboldt studied species-area relationship. He observed that within a region, the species richness increased with increasing area but upto a certain limit.

Ecologists have discovered that the value of Z lies in the range of 0.1–0.2 regardless of taxonomic group or region, i.e., whether it is plants in Britain, birds in California or molluscs in New York the slopes of the regression line are similar.

When the species-area relationship is considered for a very large area like a whole continent, regression coefficient Z or slope of the line become steeper with Z values in the range of 0.6 –1.2.

Slope of line would become steeper when the value of Z ranges from 0.6 to 1.2 as for mammals of tropical forests of different continents, the slope is found to be 1.15.

The equation of curve is $S = CA^Z$ where,

S = Species richness

C = Y – intercept

A = Area

Z = Slope of the line (regression coefficient).

The graph on species- area relationship shows that within a region, species richness increases with increasing explorable area, but only upto a certain limit. The relation between species richness and area for a wide variety of taxa turns out to be rectangular hyperbola.

(b) Tropics have more species biodiversity than the polar regions because of favourable environmental conditions as compared to polar regions where harsh conditions are prevalent. The reasons behind the maximum biological diversity of tropical regions are:

(i) **Prolonged evolutionary time** : Speciation is generally a function of time, unlike polar regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.

(ii) **High productivity** : There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.

The two reasons for more species biodiversity in tropical latitudes than in temperate ones are:

(i) Temperate region was subjected to frequent glaciations in the past, while tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.

(ii) Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity.

