Class – XII
SUB – BIOLOGY

General Instruction:

1. **All** the questions are compulsory.
2. There are26 questions in total. The question paper consists of 5 sections, A, B, C, D and E. Section **A** contains 5 questions of **one** mark each, Section **B** contains 5 questions of **two** marks each, Section **C** contains 12 questions of **three** marks each, Section **D** contains one question of **four** marks and Section **E** contains 3 questions of **five** marks each.
3. There is no overall choice. However, an internal choice has been provided in **one** question of 2 marks, **one** question of 3 marks and all **three** questions of 5 marks weightage. A student has to attempt only **one** of the alternatives in such questions.
4. Wherever necessary, labelled diagrams should be neat, drawn and labelled properly.

SECTION A

1. Why is it not possible for an alien DNA to become part of a chromosome anywhere along its length and replicate normally?

2. A segment of DNA has 1200 nucleotides, of which 400 are guanine nucleotides. What will be the number of
a) Pyrimidine nucleotides
b) Adenine-nucleotides in this DNA?

3. Write two functions of spleen in human body?

4. Why hospital waste is hazardous?

5. How can very low concentrations of bacteria and virus be detected?

SECTION B

6. Which is not a correct match –
i) Turner's syndrome XO - 45
ii) Klinefelter's syndrome XXY - 47
iii) Phenyl ketonuria XXO - 46
iv) Down's syndrome XXX - 47

7. What are the harmful effects of repeated fertilizer use?

8. How diabetes can be cured with biotechnological applications?

9. Write four factors affecting Hardy-Weinberg equilibrium.

10. What is green house effect?

OR

Why *Antirrhinum* plant shows exception to Mendelism?

SECTION C

11. What are the characteristics of helical structure of DNA?

12. a) What is a palindromic sequence in DNA?
b) How do restriction endonucleases act on palindromic sites to produce "sticky ends"?
c) What is the significance of such "sticky ends" in recombinant DNA technology?

OR

a) Describe any two methods to force an alien DNA or recombinant DNA into a host cell.
b) A recombinant DNA constructed with human DNA was introduced into a bacterial cell, but the transgenic cell did not produce the desired protein. What could be the reason for it?

13. Name the enzyme involved in the following process
a) Inspecting the length of DNA for palindromic nucleotide sequence
b) Joining of DNA fragments
c) Repeated DNA amplification
d) Breaking the cell to release DNA and other macromolecules
e) Synthesis of primers prior to replication
f) Attachment of t-RNA to its cognate amino acid

14. a) Write the biological proposals made by Oparin and Haldane, on the origin of life.
b) S. L. Miller performed an experiment to show the chemical origin of life, by recreating in the laboratory, the conditions of the primitive earth. Mention three such conditions of the primitive earth recreated and the products formed in this experiment.

15. Choose any three microbes from the following list, from which bioactive molecules are obtained. Name the bioactive molecules and their medicinal applications:
Monascus, Anabaena, Trichoderma polysporum, Spirulina, Streptococcus

16. a) How is the 'z' gene of *E. coli* used as a selectable marker in recombinant DNA technology
b) How can the DNA segments separated by gel electrophoresis be visualized later?

17. a) Write the function of RNA polymerase II in eukaryotic cells.
b) A segment of DNA, GCC AGG GGG ATG was translated into an oligopeptide Arginine- Serine-Proline- Tyrosine
i) Write the codons for these four amino acids.
ii) If the first adenine in the DNA segment is substituted by guanine.
a) What will be the mRNA transcribed by it?
b) What will be the sequence of amino acids in the new oligopeptide?
c) Write the anticodons for these amino acids?

18. Draw a schematic sketch of pBR322 plasmid and label the following in it:
a) Any two restriction sites
b) Ori and rop genes
c) Two antibiotic resistant genes

19. Briefly describe the process of decomposition.

20. Following are the steps in controlled breeding experiments-
Semen is collected from male parent-Semen is stored or immediately used ……..-Desirable mating is achieved.
Name the process and complete the missing step

21. Define-
a) Convergent evolution,
b) Divergent evolution,
c) Progressive evolution

22. What is pedigree analysis? Why pedigree analysis is done in humans to detect genetic diseases?

SECTION D

23. During rainy season Kishore's younger sister was bitten by a snake and was taken to a doctor immediately. The doctor recommended passive immunization technique.
i) What is passive immunization?
ii) Distinguish between primary and secondary immune response.

SECTION E

24. What is meant by semiconservative replication of DNA? Who provided experimental evidence for this? Describe the experiment in detail.

OR

What is primary productivity? Give brief description of factors that affect primary productivity.

25. Explain the process of sewage water treatment before it can be discharged into natural water bodies. Why is this treatment essential?

OR

Describe how the lac operon operates, both in the presence and absence of an inducer in *E. coli*

26. a) What is vaccine? How does immunity develop against a disease, when vaccine for that disease is introduced into the human body?
b) State the significance of Coelacanth in evolution.
c) How do Darwin's finches illustrate adaptive radiation?

OR

Explain the principle, procedure and significance of DNA fingerprinting.

(Answers)
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SECTION A

1. Initiation of replication occurs from a definite sequence called Ori which is generally absent in alien DNA fragment. So it has to be incorporated within an intact chromosome for replication to take place.

2. a) Pyrimidine nucleotides—600
b) Adenine nucleotides--- 200

3. Storage of both RBC and WBC and Graveyard of RBC

4. Since they contain disinfectants and other harmful chemicals and also pathogenic microorganisms.

5. By ELISA technique based on antigen-antibody interaction.

SECTION B

6. iii) Phenyl Ketonuria—XXO (46)

7. a) A part of the fertilizer supply leaches downwardly into ground water
b) Extra nitrate harms respiratory system because of the production of methaemoglobin which is unable to carry oxygen.

8. Recombinant insulin produced by the MNC, Eli Lily from the plasmids of *E. coli* is used presently to cure diabetes as it is less allergic in reaction.

9. Gene migration or gene flow, genetic drift, natural selection and genetic recombination.

10. It is derived from a phenomenon that occurs in a greenhouse. It looks like a small glass house that is used for growing plants especially during winter. It is a naturally occurring phenomenon that heats up the Earth's surface.

OR

Because it displays incomplete dominance producing both phenotypic and genotypic ratio of 1:2:1.

SECTION C

11. Double stranded right handed helical structure, shows complementary base pairing, one complete turn of the helix measures $34A^0$ with 10 base pairs present per turn of the helix, A pairs with T by two hydrogen bonds while G pairs with C by three hydrogen bonds, two strands shows opposite polarity and are anti-parallel.

12. a) Palindrome in DNA is a sequence of bases that reads same on the two strand when the orientation of reading is kept the same.
b) Restriction enzymes cut the DNA strand a little away from the centre of the palindromes but between the same two bases on the opposite strands.
c) Sticky ends form hydrogen bonds with their complementary cut counterparts, stickiness of the ends facilitates the action of DNA ligase.

OR

a) Heat shock method and micro-injection method.
b) Bacterial is more simpler in structure and genome is relatively simple due to which the recombinant protein did not get expressed in heterologous host.

13. a) Restriction endonuclease
b) DNA ligase
c) Taq polymerase
d) lysozyme or chitinase or cellulose
e) primase
f) amino-acyl t-RNA transferase

14. a) The first form of life could have come from pre-existing non-living organic molecules and that formation of life was preceded by chemical evolution.
b) Electric discharge was created in a closed flask containing methane, ammonia, water vapour at 800^{0}c. Conditions on Earth were high temperature, volcanic eruption and reducing atmosphere. He observed the formation of amino acids.

15. *Monascus*—produces statins which act as blood cholesterol lowering agent
Trichoderma polysporum-- Cyclosporin A ---immunosuppressive agent in organ transplanted patients.
Streptococcus--- Produces Streptokinase which acts as clot buster.

16. a) "z" gene responsible for the enzyme β-galactosidase in *E.coli.* The cells having the insert will behave as transformed cells and can be distinguished easily from non-transformed cells.
b) The separated DNA fragments can be visualized after staining the DNA with ethidium bromide followed by exposure to UV radiation.

17. a) It transcribes the precursor of mRNA, the hnRNA.
b) i) CGGUCCCCCUAC
ii) CGGUCCCCCCAC
iii) Arginine—Serine-Proline-Histidine
iv) GCCTGGGGGGTG

18.

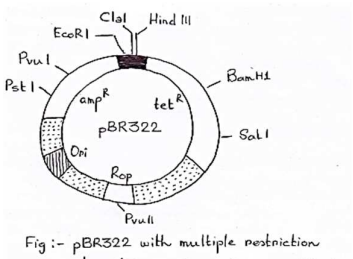

Fig :- pBR322 with multiple restriction sites (EcoR1, BamH1), ori, antibiotic resistance genes (amp^R and tet^R), ori and rop genes.

19. Includes 5 steps- fragmentation, leaching, catabolism, humification and mineralization. Fragmentation involved breakdown of detritus into smaller particles. Leaching precipitates water soluble inorganic nutrients as unavailable salts. Detritus is decomposed into smaller inorganic substances by catabolism. Humification leads to the formation of humus which degrades releasing inorganic nutrients by mineralization.

20. Semen is introduced into the female genital tract by trained technicians. This process is called Artificial insemination.

21. a) Convergent evolution in that evolution in which different structures evolve for same functions and hence shoe similarity.

b) Divergent evolution in that evolution in which same structure developed along different directions due to adaptations to different needs.
Progressive evolution is moving forward in a particular direction showing specialization of structures already in existence.

22. An analysis of traits in several generations of a family is called pedigree analysis. Here the inheritance of a particular trait is represented in the family tree over generations. Due to complexity of genes and huge structure of the human genome, control crosses are not possible in human, so pedigree analysis is the only alternative for detecting genetic disorders.

SECTION D

23. i) When a person is infected with some deadly microbes to which some quick response in needed. Preformed antibodies or antitoxin is directly injected into the patient's body. This is called passive immunization.

ii) Primary immune response is of low intensity and takes longer time to be generated while secondary immune response is more vigorous and takes a comparatively shorter time to be generated. It is based on the memory of the immune system.

SECTION E

24. After completion of replication, each DNA molecule consists of one parental and one newly synthesized strand. This is called semi-conservative replication.
Mathew Meselson and Franklin Stahl proposed this model of semi-conservative replication.
Colonies of *Escherichia coli* are grown in a nutrient medium containing N^{15} for several generations. The heavy isotope got incorporated in nitrogen compounds including DNA. When the whole DNA was found to contain heavy isotope of nitrogen, bacteria were shifted to culture medium containing normal nitrogen N^{14}. After 20 minutes DNA was isolated from the cells of each generation and was tested for the presence of Heavy and light DNA. Comparing the heaviness of DNA of each generation, it was found that DNA of the generation having completely heavy isotope was the heaviest. In the second generation (40 minutes) DNA formed two sediments, one at a level of DNA of first generation and the second at a still higher level. The DNA of the first generation was of intermediate density

containing both N^{15} and N^{14}. Second generation produced two types of DNA – one having N^{15}/N^{14} and the other N^{14}/N^{14}. This proves semi-conservative replication.

OR

The rate of synthesis of biomass by producers per unit time per unit area through photosynthesis is known as primary productivity. The factors affecting primary productivity are

i) Sunlight- More productivity and photosynthesis occurs in tropics but decreases progressively towards the poles.
ii) Temperature-Temperate forests have lesser productivity as compared to tropical forests due to cold climate during winter, Alpine and arctic regions have very low productivity.
iii) Moisture- Good rain and humidity increase productivity throughout the ecosystem. Productivity decreases due to fall in water availability.
iv) Nutrients- Regular availability of nutrients is required for productivity of an ecosystem. Hence some ecosystems have low productivity while some have high productivity.
v) Photosynthetic efficiency- certain plants are more efficient in trapping sunlight than others, hence their productivity will be higher than that of others.

25. Sewage treatment is carried out in 2 stages: **Primary treatment** –Involves physical removal of particles by two processes—Filtration and sedimentation. Solids settle at the bottom forming primary sludge while the supernatant also called effluent is taken for next step.

Secondary Treatment -- Primary effluent --- large aeration tanks—aerobic microbes--- major part of organic matter consumed leading to fall in BOD--- Effluent passed into settling tank--- Activated sludge--- a part of activated sludge is pumped back into aeration tank to serve as inoculum--- Anaerobic bacteria--- produces a mixture of gases called biogas by fermentation.

This method is very essential as it relatively purifies the water before it is discharged into water bodies. Also it leads us to believe that microbes play an important role in treating waste water.

OR

In the presence of inducer lactose, the repressor is made inactive by the binding of inducer with the repressor. Consequently the operator being active, transcription of the structural genes takes place leading to the formation of the enzymes. When inducer is absent or exhausted, the repressor remains active which binds to the operator region and prevents RNA polymerase from transcribing the operon.

26. a) Vaccine is a suspension of killed or attenuated pathogenic micro-organism or antigenic preparations made out of it which provides immunity towards the pathogen.

After vaccination, immunization develops due to the formation of memory cells by the immune system. When a vaccinated person receives an infected dose of the pathogen, the existing memory T- or B- cells recognize the antigen and induce a massive formation of T- cells, B- cells and antibodies for elimination of the invaders.

b) Coelacanth evolved into first amphibians that lived on both land and water.
c) Darwin's finches evolved on the Galapagos Islands itself and from the original seed-eating features, many other features with altered beaks arose, enabling them to become insectivorous and vegetarian finches. Hence they exhibited adaptive radiation.

OR

Principle- DNA fingerprinting consists of identifying differences in some specific regions of DNA sequence called repetitive DNA as in these sequences, a small stretch of sequences is repeated many times. Repetitive DNA get separated from the bulk genomic DNA during density gradient centrifugation. These sequences show high degree of polymorphism and form the basis of DNA fingerprinting.

Procedure- It involves the following steps-

Isolation of DNA, Digestion of DNA by restriction endonucleases, Separation of DNA fragments by electrophoresis, transferring of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon, Hybridization using labelled VNTR probe, Detection of labelled DNA fragments by autoradiography.

Applications – Identification of criminals involved in crimes, solving maternity-paternity disputes, establishment of closeness of relation of an intending immigrant and Provides information as to human lineage and relationship with other apes.