Solution

Class 12 - Biology

2020-21 paper 3

Section A

1. Sexual reproduction occurs in female Anopheles, while asexual reproduction occurs in man.
2. The carbon dioxide (CO_2) released during fermentation is responsible for the rising of the dough.
3. Sal I is one of the restriction site in pBR 322 plasmid. When an alien gene is ligated at this site, it forms a recombinant-DNA.
4. (i) Morphine
   (ii) Tranquillizers
5. Due to the insertion of gene of interest within the gene the functioning of the gene is inactivated i.e. the concerning enzyme is not produced.
6. i. Cyclosporin A is obtained from fungus Trichoderma polysporum, used in organ transplant patients.
   ii. Statin is produced by the yeast Monascu purpureus, acts by competitively inhibiting the enzyme responsible for the synthesis of cholesterol.
7. Cannabinoids are obtained from *Cannabis sativa*. Marijuana and hashish are examples of cannabinoids. They affect the cardiovascular system.
8. a. Streptococcus
   b. Fungus
   c. Cyclosporin A
   d. Clostridium butylicum
9. A: Denaturation
   B: Annealing
   C: Extension
10. All normal cells have cellular oncogenes (c-onc) or proto oncogenes when activated under certain conditions, can lead to oncogenic transformation of cells.

    OR

    Competent means bacterial cells, on treatment with $CaCl_2$ (Calcium Chloride) are made capable of taking up foreign DNA.
11. **(a)** Both Assertion and Reason are true and the Reason is the correct explanation of the Assertion
    Explanation: The IgE-primed mast cell releases granules and powerful chemical mediators, such as histamine, cytokines, granulocyte-macrophage colony-stimulating factor (GM-CSF), leukotrienes, heparin, and many proteases into the environment. These chemical mediators cause the characteristic symptoms of allergy.
12. **(a)** Assertion is correct but reason is incorrect.
    Explanation: The dough used for making food such as dosa and idli is fermented by bacterial. The puffed-up appearance of dough is due to the production of carbon dioxide gas.
13. 1. Palindromic nucleotide sequences
14. **(a)** The assertion is correct but the reason is wrong
    Explanation: *Taenia solium* completes its life cycle in humans as the definitive host and pigs as intermediate hosts. It is transmitted to pigs through human feces or contaminated fodder, and to humans through uncooked or undercooked pork.
    The malarial parasite completes their life cycle in two hosts human beings and female anopheles mosquito.
15. i. (d) methane, carbon dioxide and hydrogen
    ii. (c) Methanobacterium
    iii. (d) both (b) and (c)
    iv. (c) Methanobacterium is an aerobic bacterium found in the rumen of cattle
    v. (b) a - digester, b - sludge
16. i. (c) blood cholesterol lowering statins
    ii. (a) insecticides

iii. (b) Aspergillus niger
iv. (a) Immunosuppressive agent in organ-transplant patients
v. (d) Both the statement are false

Section B

17. (a) MALT - Mucosal associated lymphoid tissue
(b) CMI - Cell Mediated Immunity
(c) AIDS - Acquired Immuno Deficiency Syndrome
(d) NACO - National AIDS control Organisation
(e) HIV - Human Immuno Deficiency Virus.
18. Following are some of the uses:
    i. As medicine against pathogenic diseases.
    ii. As a preservative in perishable fresh food articles e.g., meat, fish.
    iii. A feed supplement for animals especially poultry birds.
19. A bioreactor provides five growth conditions for obtaining the desired products are:
    i. facilitate the mixing of reactor contents
    ii. oxygen availability through oxygen delivery system
    iii. foam control system
    iv. temperature control system
    v. pH control system and sampling parts for examining small volume of cultures periodically.
20. The basic definition of biotechnology says is a set of methods to use live organisms to produce products and processes for the benefit of humankind. So, it is correct to include a winemaker, as well as a molecular biologist under the category of biotechnologies as one has developed a recombinant vaccine and the other has developed wine using living organisms for human welfare.
21. As defined by World Health Organization (WHO), health is a "State of complete physical, mental, and social well being, and not merely the absence of disease or infirmity."
    Health is a dynamic condition resulting from a body's constant adjustment and adaptation in response to stresses and changes in the environment for maintaining an inner equilibrium called homeostasis.
    Good health can be maintained through balanced diet and regular exercise.
22. 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. **Competent host** (usually bacteria/yeast): to take up recombinant DNA.
23. Metastasis is the spread of a cancer or other disease from one organ or part of the body to another without being directly connected with it. The new occurrences of disease thus generated are referred to as metastases (mets).
    The spreading of cancer cells to distant sites through blood and lymph is called metastasis or by this process cancer cells move to various body parts from the area of formation and produce secondaries.

    OR

    i. Simple stirred tank bioreactor
    ii. Sparged stirred-tank bioreactor

    Importance:

    i. Even -mixing and oxygen availability through the bioreactor.
    ii. Provides optimal conditions for growth such as temperature, pH, and foam control systems, sampling ports, etc.
    iii. A large amount of the raw material substrates are biologically converted into specific products such as vitamins, enzymes, etc., on a commercial scale.
24. i. The organic farmers do not recommend eradication of insect pests as, without them, the beneficial predatory and parasitic insects, which depend upon pests as food or hosts would not be able to survive.
    ii. The ladybird beetles and dragonflies feed upon aphids and mosquitoes respectively. Hence, they act as biocontrol agents by helping farmers to get rid of them.
25. Following are the different steps involved in genetic engineering:

i. Identification and isolation of agronomically important genes.
ii. Cloning of isolated genes in a vector.
iii. Introduction of a gene into plant protoplast cell/tissues with the use of the gene transfer method.
iv. Integration of foreign gene in the transgenic plants by using molecular techniques.
v. Culture and regeneration of complete plant on suitable selection medium.

OR

A 'suitable gene' refers to a specific DNA segment which can be injected into the cells of the host body to produce specific proteins. This protein kills the specific disease-causing organism in the host body and provides immunity.

Section C

26.

Innate Immunity	Acquired Immunity
Non-specific	Specific
Is present from bith	Is acquired in response to a specific pathogen
Involves different types of barriers	Involves memory of antibody
Example: Skin acts like a barrier	Example: Antibody response after vaccination

27. Both are right because biotechnology is a very wide area. It 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 winemaker employs a strain of yeast to produce wine by fermentation (a natural phenomenon), while the molecular biologist has cloned the gene for the antigen (that is used as a vaccine) in an organism, which allows the production of the antigen in the large amount.
28. In modern times, many children are kept under a protective environment at an early age. They are not exposed to the external environment. This lowers the immunity against the hazards of the environment and is the main cause of allergic reactions in those children. Due to this, many children in the metropolitan cities of India suffer from allergy/asthma.
Some symptoms of allergic reactions are; coughing, sneezing, breathlessness, etc.
29. Passive smoking is definitely more dangerous than active smoking. A smoker is aware about the dangers of smoking and is doing it deliberately. But a non-smoker does not do it deliberately but situations force him/her to inhale the smoke. While epidemiological data show a higher prevalence of smoking-related diseases in smokers but still passive smoking is more dangerous because of non-intension factor involved in it.
30. The naming of Restriction enzymes is as follows:
    i. The first letter of the name comes from the genus and the next two letters from the name of the species of the prokaryotic cell from which they are isolated.
    ii. The next letter comes from the strain of the prokaryote.
    iii. The roman numbers following these four letters indicate the order in which the enzymes were isolated from that strain of the bacterium. Examples:
        a. EcoR I is isolated from *Escherichia coli*, RY 13.
        b. Hind II is from *Haemophilus influenzae*.
        c. Bam H I is from *Bacillus amyloliquefaciens*.
        d. Sal I is from *Streptomyces albus*.
        e. Pst I is from *Providencia stuartii*.

OR

DNA	RNA
It usually occurs inside the nucleus and some cell organelles.	Very little RNA occurs inside the nucleus. Most of it is found in the cytoplasm.
DNA is the genetic material.	RNA is not the genetic material except in certain viruses, e.g., TMV, Reovirus.
It is double-stranded with the exception of some viruses(e.g.,$\phi \times 174$).	RNA is single-stranded with the exception of some viruses(e.g., double-stranded in Reovirus).
DNA shows regular helical coiling.	There is no regular coiling except in parts of tRNA.

It is Fuelegen positive.	RNA is Fuelgen negative.
DNA contains several million nucleotides.	Depending upon the type, RNA contains 70-12000 nucleotides.
DNA is of only two types, nuclear and extranuclear.	There are at least three types of RNA-mRNA, rRNA and tRNA.

Section D

31. **Pulse Polio:** This is a mass immunization program to eradicate poliomyelitis from India. This program was launched in 1995-96. This program has been undertaken with active cooperation from government agencies, NGOs, UNICEF, and CDC.

Key Objectives of Pulse Polio:

i. Not a single child should be missed.
ii. High level of surveillance.
iii. Reporting of any new case within 14 days.

Polio booths are settled throughout the country to cover all the children below 5 years of age. Volunteers are hired to administer the polio vaccine.

OPV (Oral Polio Vaccine): OPV is an attenuated vaccine. It is produced by the passage of the virus through non-human cells at a sub-physiological temperature. This produces spontaneous mutation in the viral genome.

A single vial of OPV usually contains 10-20 doses.

On 27th March 2014, WHO declared India a polio-free nation as no new case was reported in the last 3 years.

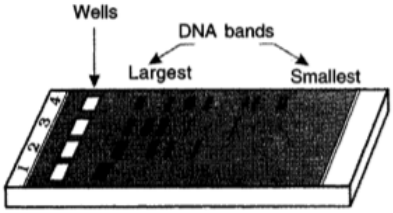
OR

Genetic engineering is the technique of altering the nature of DNA and RNA and/or the introduction of it into a host organism and thus changing the phenotype of the organism. The technique of genetic engineering include:

i. Creation of recombinant DNA/Recombinant DNA technology: It involves
   a. Isolation of DNA from bacterial cells/plant or animal cells by using enzymes such as lysozyme, cellulase and chitinase. DNA is a collection of fine threads in the suspension.
   b. Fragmentation of DNA is carried out by restriction enzymes. A similar process is repeated with vector (Plasmid, phage) DNA.
   c. DNA segments are separated and isolated by the technique of gel-electrophoresis,
   d. Isolated desired DNA fragment or copy of the amplified gene of interest (PCR technique) and the cut vector with space are mixed and ligase enzyme is added.
ii. Formation of r-DNA by cloning of alien DNA and vector DNA. (Ligation of DNA fragment into a vector)
iii. Transfer of r-DNA into the host by
   a. Making the host competent to take in DNA
   b. Micro-injection
   c. Biolistic or gene gun
   d. disarmed pathogen vectors which when allowed to infect the cell, transfer the r-DNA into the host. As a result of this technique, a genetically modified cell is produced.

32. i. Cutting DNA at specific location:-
   a. Fragmentation of DNA is carried out by incubating purified DNA molecules with restriction enzyme at optimal conditions of temperature and pH for that specific enzyme.
   b. Agarose gel electrophoresis technique is employed to check the progression of restriction enzyme digestion.
   c. The similar process is repeated with vector DNA.
ii. Separation and isolation of DNA fragment:- It is carried out by technique gel-electrophoresis.
   a. DNA fragments being negatively charged, can be separated by forcing them to move towards anode under an electric field through a medium/matrix (agarose). DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. The smaller the

fragment size, the farther it moves.



b. DNA fragments can be visualised by staining DNA with ethidium bromide followed by exposure to UV radiations. Bright orange colour bands of DNA become prominent in the gel. The separated bands of DNA are cut out from the gel and extracted from the gel piece. This step is known as elution.
c. Purified DNA fragments are used for reconstructing recombinant DNA by joining them with cloning vectors.

OR

Process of secondary treatment given to sewage water:

i. The primary effluent is passed into large aeration tanks where it is constantly agitated mechanically and the air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs which are masses of bacteria associated with fungal filaments to form mesh-like structures.
ii. While growing, these microbes consume the major part of the organic matter in the effluent. This significantly reduces the BOD (biochemical oxygen demand) of the effluent. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidised by bacteria.
iii. The sewage water is treated until the BOD is reduced. The greater the BOD of wastewater, more is its polluting potential.
iv. Once the BOD of sewage or wastewater is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called activated sludge.
v. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum.
vi. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters where anaerobic bacteria digest these bacteria and fungi in the sludge.
vii. During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulfide and carbon dioxide.
viii. The effluent from the secondary treatment plant is generally released into natural water bodies like rivers and streams.

Another benefit provided by this process:

During this process, bacteria produce a mixture of gases such as methane, hydrogen sulfide and carbon dioxide which form biogas. It can be used as a source of energy as it is inflammable.

33. Roles of 'floes' and 'activated sludge' in sewage treatment are as follows:

i. **Flocs:** These are masses of bacteria held together by slime and fungal filaments to form mesh-like structures. These are used during the secondary sewage treatment in the aeration tank to increase the rate of decomposition. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As a result, BOD of the sewage reduces. As the BOD of waste is reduced to 10-15% of raw sewage, it is passed into the settling tank. In these tanks, flocs are allowed to undergo sedimentation.
ii. **Activated sludge:** The sediment of settling tank is called activated sludge. A part of it is used as inoculum in aeration tanks. The remaining part is passed into a large tank called anaerobic sludge digester. In these tanks, anaerobic microbes are present that digest the organic mass as well as aerobic microbes of activated sludge. The remaining sludge is used as manure or compost.

OR

The vaccine is a preparation/suspension or extract of dead/attenuated (weakened) germs of a disease which on inoculation produce antibodies that provide temporary/permanent active/passive immunity to a healthy person.

Types of Vaccines: Vaccines are of following types:

i. Live Vaccines or Attenuated Vaccines: Live vaccines are prepared from live (generally attenuated-the pathogen is made weakened to make it nonvirulent) organisms. Examples: OPV, (Oral Polio Vaccine), BCG,

(Bacillus Calmette Guerin), smallpox, yellow fever vaccine, Influenza vaccine. These vaccines provide active lifelong immunity.

ii. Killed Vaccines or Inactivated Vaccines: These vaccines are prepared by killing the pathogenic organisms by heat/ultraviolet rays/alcohol/formalin/phenol. Examples: Typhoid vaccine, Salk Polio Vaccine, Typhus Vaccine, Cholera Vaccine, Rabies Vaccine, Plague Vaccine, TAB Vaccine.

iii. Toxoids: Certain organisms such as Diphtheria and Tetanus bacilli produce toxins. The toxins produced by these organisms are detoxicated and used in the preparation of vaccines. Examples: Diphtheria toxoid and Tetanus Toxoid. These vaccines provide passive immunity for a short period.

iv. Cellular Fractions: Vaccines in certain instances are prepared from extracted cellular fraction. Examples: Meningococcal vaccine from the polysaccharide antigen of the cell wall, the pneumococcal vaccine from the polysaccharide contained in the capsule of the organism and hepatitis-B polypeptide vaccines.

v. Combinations: If more than one kind of immunizing agent is included in the vaccine, it is called a mixed or combined vaccine. The following are some of the well known combinations : DPT (Diphtheria + pertussis + tetanus), DT (Diphtheria + tetanus), DP (Diphtheria + pertussis), Tetanus + Influenza, DPT and typhoid Vaccine, MMR (Measles + mumps + rubella), Measles + rubella.