Code Number: **A**

Corp. Office: Aakash Educational Services Limited, 3rd Floor, Incuspaze Campus- 2, Plot No. 13, Sector- 18, Udyog Vihar, Gurugram, Haryana - 122015

Time: 3 hrs. **Mock Test Paper for Class-XII** **Max. Marks: 60**

BOTANY

Answers & Solutions

1. **Cohesion** – mutual attraction between water molecules.

   Adhesion – attraction of water molecules to polar surfaces (such as the surface of tracheary elements).

   Surface Tension – water molecules are attracted to each other in the liquid phase more than to water in the gas phase.

2. A genophore is the genetic material (DNA) of prokaryotes, such as bacteria and archaea. It is also known as the prokaryotic chromosome or bacterial chromosome. it lacks histones proteins and true chromatin structure.

3. If a mutation arise due to change in a single base pair of DNA is called point mutation. Example of such a mutation is sickle cell anemia.

4. This technique of growing plants in a nutrient solution is known as Hydroponics.

5. Addition of an unusual nucleotide (methyl guanosine triphosphate) to the 5'-end of hnRNA is called **Capping**.

   Addition of adenylate residues (200-300) are added at 3'-end in a template independent manner is called **Tailing**.

6. **Downstream processing** is the series of steps used to **separate, purify, and formulate** the desired product after its production in a bioreactor (fermentation), before it is marketed for use.

7. A period of rapid increase in food grain production achieved by using high-yielding variety seeds, fertilizers, irrigation, and modern farming practices. Father of Green Revolution is Norman Borlaug at World level, M.S. Swaminathan is considered as Father of Green Revolution in India.

8. A. *Saccharum barberi* B. *Saccharum officinarum*.

9. Nucleopolyhedro virus are excellent candidates for species-specific, narrow spectrum insecticidal applications. They have been shown to have no negative impacts on plants, mammals, birds, fish or even on non-target insects.

10. **Nematode:** *Meloidogyne incognita* (root-knot nematode)

Prevention strategy: RNA interference (RNAi) using transgenic tobacco plants that produce double-stranded RNA to silence essential nematode genes, preventing infection.

11. 1. **Recognition and attachment:** Legume roots secrete flavonoids that attract Rhizobium. In response, bacteria produce ***Nod*** factors, leading to specific attachment to root hairs.

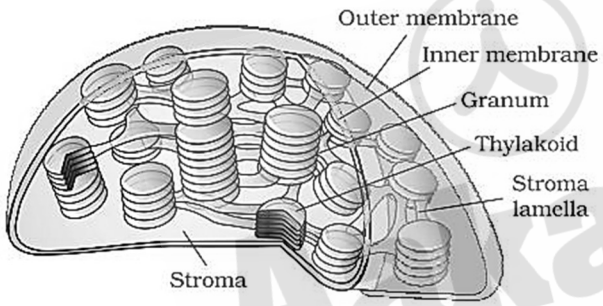
2. **Root hair curling:** The ***Nod*** factors induce curling and deformation of the root hairs. The bacteria get trapped in the curled root hair tip, forming an entry point for infection.

3. **Infection thread formation:**

An infection thread develops from the curled root hair and grows inward. The *Rhizobium* bacteria multiply and move through this infection thread towards the root cortex.

4. **Nodule development and nitrogen fixation:** Cortical cells divide to form a nodule Inside these cells, bacteria differentiate into **bacteroids**. These bacteroids fix atmospheric nitrogen into ammonia using the enzyme **nitrogenase**, which is protected from oxygen by **leghemoglobin** present in the nodule.

12.



13. Non-protein constituents of proteins called co factors are bound to the the enzyme to make the enzyme catalytically active. Cofactors are non-protein helpers for enzymes, mainly divided into **Inorganic Ions** (like Zinc, Magnesium) and **Organic Cofactors**, with organic ones further split into loosely bound Coenzymes (e.g., NAD, FAD from vitamins) and tightly bound Prosthetic Groups (e.g., Heme in catalase), all crucial for enzyme activity. The protein portion of the enzymes is called the apoenzyme. Three kinds of cofactors may be identified: prosthetic groups, co-enzymes and metal ions.

14. ICTV (International Committee on Taxonomy of Viruses).

An international body that classifies and standardizes the **naming and taxonomy of viruses**.

Viruses are named based on:

Type of nucleic acid (DNA or RNA)

Morphology (shape, symmetry, envelope)

Mode of replication

Host organism infected

Disease/symptoms caused.

15. Bt cotton is a **genetically modified (GM) crop** developed by inserting **cry genes** from the bacterium

Bacillus thuringiensis into cotton plants. These genes produce **Bt toxin (Cry protein)**.

The toxin is **insecticidal**, specifically effective against **bollworms** (cotton bollworm, pink bollworm). When the insect feeds on Bt cotton, the **inactive protoxin** is activated in the **alkaline gut**, binds to gut epithelial cells, creates pores, causes cell lysis, and leads to **death of the insect**.

Advantages:

- Provides **inbuilt pest resistance**
- Reduces **use of chemical insecticides**
- Increases **yield and farmer income**
- Environment-friendly and target-specific

Bt cotton is the **first GM crop commercialized in India** and is widely used in cotton cultivation.

16. **Co-dominance.** Co-dominance is a form of inheritance in which both alleles of a gene express themselves fully and equally in a heterozygous individual, without blending.

Example – Human ABO blood group:

The gene *I* has three alleles: I^A, I^B, *i*.

I^A produces A antigen, I^B produces B antigen

When I^A and I^B are present together (I^AI^B), both A and B antigens are expressed, resulting in blood group AB. Thus, neither allele is dominant over the other they are co-dominant.

17. Seed dormancy is a condition in which a viable seed fails to germinate even under favourable environmental conditions like adequate water, oxygen and suitable temperature.

Causes of seed dormancy:

Hard or impermeable seed coat

Immature embryo

Presence of germination inhibitors (e.g., abscisic acid)

Requirement of specific conditions like light, chilling (vernalization), or after-ripening.

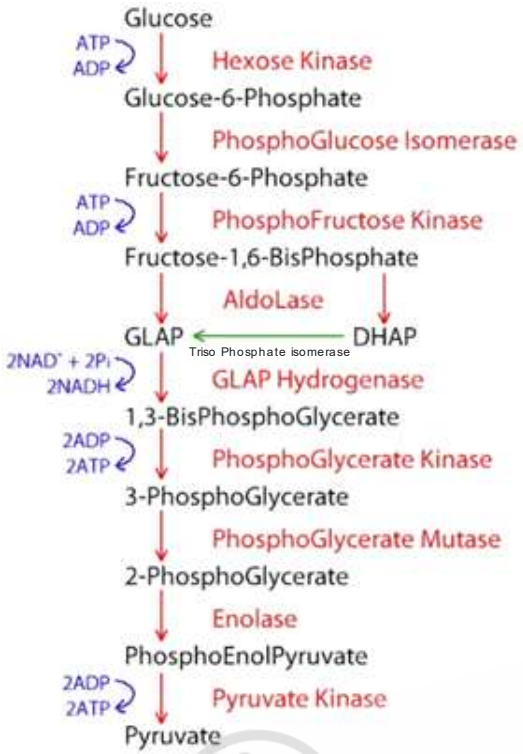
18. In **eukaryotic cells**, **three types of RNA polymerases** are present:

1. RNA polymerase I
   Function: Synthesizes rRNA (28S, 18S, 5.8S)
2. RNA polymerase II
   Function: Synthesizes hnRNA (pre-mRNA) → mRNA
   Also synthesizes some snRNA
3. RNA polymerase III
   Function: Synthesizes tRNA, 5S rRNA, and some snRNA

   Prokaryotes have only one RNA polymerase for all types of RNA.

19. In Glycolysis one molecule of glucose (6C) is converted into two molecules of pyruvate (3C) through a sequence of enzyme-catalysed reactions. It is also called the Embden–Meyerhof–Parnas (EMP) pathway.

Glycolysis takes place in the cytoplasm of all living cells, including prokaryotes and eukaryotes.



Steps of Glycolysis

1. Preparatory phase:

   Glucose is phosphorylated using 2 ATP molecules and converted into fructose-1,6-bisphosphate. Further converted to two 3-carbon molecules Glyceraldehyde-3-phosphate (G3P) and dihydroxyacetone phosphate (DHAP).

   DHAP is converted into G3P, so both molecules follow the same pathway.

2. Energy generation phase:

   G3P is oxidized to form pyruvate.

   NAD^+ is reduced to NADH.

   ATP is produced by substrate-level phosphorylation.

   End Products of Glycolysis (per glucose):

   2 molecules of pyruvate, Net gain of 2 ATP (4 formed – 2 used), 2 NADH + 2 H^+

Significance of Glycolysis:

Provides immediate energy to the cell.

Acts as a common pathway for aerobic and anaerobic respiration.

Produces intermediates for other metabolic pathways like Krebs cycle and fermentation.

20. Recombinant DNA (rDNA) technology relies on key tools:

Restriction Enzymes (molecular scissors like *EcoRI* cut DNA at specific sites, creating sticky/blunt ends), DNA Ligase (molecular glue that joins DNA fragments, often the gene of interest to the vector), Vectors (carriers like plasmids or phages that transport foreign DNA into host cells, possessing Origin of Replication

(ORI) and selectable markers), and a Host Organism (like *E. coli* or yeast) that replicates the rDNA, enabling gene cloning and production. Polymerases (for DNA synthesis) and modern tools like CRISPR are also vital.

1. Restriction Enzymes (Molecular Scissors)

   Function: Recognize specific DNA sequences (palindromes) and cut the DNA strand, creating fragments with "sticky ends" or "blunt ends".

   Types: Endonucleases cut within the strand; exonucleases remove nucleotides from the ends.

   Examples: *EcoRI, HindIII*.

2. DNA Ligase (Molecular Glue)

   Function: Catalyzes the formation of phosphodiester bonds, joining the desired gene fragment to the vector DNA.

3. Vectors (Carriers)

   Function: DNA molecules (plasmids, viruses) that carry the foreign DNA into a host cell for replication.

   Key Features: Origin of Replication (ORI), selectable markers (e.g., antibiotic resistance), and restriction sites.

   Examples: Plasmids (pBR322), Bacteriophages, Cosmids, Yeast Artificial Chromosomes (YACs).

4. Host Cells (Replicating Machines)

   Function: The organism (bacteria, yeast, plant/animal cells) that takes up the recombinant DNA and multiplies it.

   Process: Recombinant DNA is inserted via methods like microinjection, gene gun (biolistics), or chemical treatment (calcium ions).

5. Other Essential Tools

   Polymerase Enzymes: Synthesize new DNA strands (e.g., Taq polymerase in PCR).

   CRISPR-Cas9: Advanced gene-editing tools for precise DNA modification.

21. Sewage contains a large amount of organic matter and pathogenic microorganisms. Microbes play a crucial role in the biological treatment of sewage by decomposing organic wastes and reducing the biochemical oxygen demand (BOD).

Primary Treatment:

This is a physical process involving screening and sedimentation to remove large debris and suspended solids. Microbes are not actively involved in this stage.

Secondary Treatment:

(Biological Treatment) This is the most important stage involving microorganisms.

Sewage is passed into aeration tanks, where it is continuously aerated.

Aerobic bacteria and fungi form flocs (masses of bacteria associated with fungal filaments).

These microbes oxidize organic matter into CO_2 and water, thereby reducing BOD.

When BOD is sufficiently reduced, the effluent is transferred to a settling tank, where flocs settle as activated sludge.

A part of the activated sludge is recycled back into the aeration tank as inoculum.

The remaining sludge is sent to anaerobic sludge digesters.

Anaerobic bacteria, including methanogens (*Methanobacterium*), digest organic matter.

They produce biogas containing methane, CO_2, and H_2S. Biogas can be used as a source of energy.

Secondary treatment removes pathogens and organic load. Treated sewage can be released into natural water bodies or further treated by tertiary treatment if needed.

Thus, microbes are indispensable in sewage treatment, making the process eco-friendly and efficient.