

Previous IPE  
**SOLVED PAPERS**

**MARCH -2025 (AP)**

**PREVIOUS PAPERS****IPE: MARCH-2025(AP)****Time: 3 Hours****SR BOTANY****Max. Marks: 60****SECTION-A****I. Answer ALL the following VSAQ:****10 × 2 = 20**

1. What are porins? What role do they play in diffusion?
2. Where does the photolysis of H<sub>2</sub>O occur? What is its significance?
3. What are pleomorphic bacteria? Give an example.
4. What is point mutation? Give an example.
5. What is meant by charging of tRNA?
6. Distinguish between heterochromatin and euchromatin. Which of the two is transcriptionally active?
7. Give one example for each of transgenic plants which are suitable for food processing and those with improved nutritional quality.
8. What is the full form of PCR? How is it useful in biotechnology?
9. Why does 'Swiss cheese' have big holes. Name the bacteria responsible for it.
10. Give two examples of fungi used in SCP production.

**SECTION-B****II. Answer any SIX of the following SAQs:****6 × 4 = 24**

11. Write briefly about enzyme inhibitors.
12. Define and explain water potential.
13. Explain the steps involved in the formation of root nodule.
14. What are the physiological processes that are regulated by ethylene in plants.
15. Explain the structure of TMV.
16. Define and design a test-cross.
17. What are the differences between DNA and RNA?
18. Give a brief account of Bt cotton.

**SECTION-C****II. Answer any TWO of the following LAQs:****2 × 8 = 16**

19. Give an account of glycolysis. Where does it occur? What are the end products? Trace the fate of these products in both aerobic and anaerobic respiration.
20. Explain briefly the various processes of recombinant DNA technology.
21. Describe the tissue culture technique and what are the advantages of tissue culture over conventional method of plant breeding in crop improvement programmes?

# IPPE AP MARCH-2025

## SOLUTIONS

### SECTION-A

1. What are porins? What role do they play in diffusion?

- A:**
- 1) **Porins** are a kind of **protein channels**.
  - 2) They form **huge pores** on the outer membranes of plastids, mitochondria and some bacteria.
  - 3) They allow small sized protein molecules to diffuse through them.
  - 4) Thus, porins cause **facilitated diffusion**.

2. Where does the photolysis of  $H_2O$  occur? What is its significance?

- A:**
- 1) Photolysis of  $H_2O$  occurs in grana of chloroplast.
  - 2) **Significance:** During photolysis oxygen is evolved. It is the main source of atmospheric oxygen

3. What are pleomorphic bacteria? Give an example.

- A:**
- 1) The bacteria which are capable of changing their shape depending on the environmental conditions, nutrition are called pleomorphic bacteria.
  - 2) **Ex:** Aceto bacter.

4. What is point mutation? Give an example.

- A:**
- 1) **Point mutation:** It is the mutation that occurs in a single base pair of DNA fragment.
  - 2) **Ex:** Sickle cell anemia.

5. What is meant by charging of tRNA?

- A:** **tRNA:** Activation of aminoacids, in the presence of ATP and linking to their cognate tRNA, is known as charging of tRNA.

6. Distinguish between heterochromatin and euchromatin. Which of the two is transcriptionally active?

<b>A:</b>	<b>Heterochromatin</b>	<b>Euchromatin</b>
	<ol style="list-style-type: none"> <li>1) The chromatin that is more densely packed and stains dark is called Heterochromatin.</li> <li>2) It is transcriptionally inactive.</li> </ol>	<ol style="list-style-type: none"> <li>1) The chromatin that is loosely packed and stains light is called Euchromatin.</li> <li>2) It is transcriptionally active.</li> </ol>

7. Give one example for each of transgenic plants which are suitable for food processing and those with improved nutritional quality.

- A:**
- 1) **Transgenic plant suitable for food processing:** "Flavr Savr" variety of tomato.
  - 2) **Transgenic plant with improved nutritional value:** Taipei golden rice with vitamin A rich nature.

**8. What is the full form of PCR? How is it useful in biotechnology?**

- A:** 1) Full form of PCR is Polymerase Chain Reaction.  
2) PCR technique is used in (i) DNA cloning (ii) gene amplification (iii) DNA finger printing
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**9. Why does 'Swiss cheese' have big holes. Name the bacteria responsible for it.**

- A:** 1) Large holes in 'Swiss cheese' are due to the production of large amounts of CO<sub>2</sub>.  
2) The Bacterium Propionibacterium is responsible for it.
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**10. Give two examples of fungi used in SCP production.**

- A:** 1) *Candida utilis* (Torula Yeast)  
2) *Saccharomyces cerevisiae* (Baker's yeast)

BABY BULLET-Q

## SECTION-B

### 11. Write briefly about enzyme inhibitors.

**A: Enzyme Inhibitors:** These are the chemicals which stop the activity of the enzymes. Those chemicals are called "inhibitors" and the process is called inhibition. The inhibitors are three types. They are 1) Competitive inhibitors 2) Non-competitive inhibitors 3) Feed back inhibitors.

**1) Competitive inhibitors:** The inhibitors that resemble the substrate molecules and prevents the activity of the enzyme are called competitive inhibitors.

**Ex:** Malonic acid resembles the substrate succinate and it inhibits the succinic dehydrogenase.

**2) Non-competitive inhibitors:** The inhibitors having no structural similarity with the substrate and binding to an enzyme of locations other than the active sites so that the globular structure of the enzyme is changed are called non-competitive enzyme inhibitors.

**Ex:** Metal ions of Copper, Mercury.

**3) Feed back inhibitors:** Feed back inhibition is a cellular control mechanism in which an enzyme's activity is inhibited by the enzyme's end product.

It is a part of homeostatic control metabolism.

### 12. Define and explain water potential .

**A: Water potential ( $\psi_w$ ):** Water potential is the measure of movement of water from one part to the another part within the plant. It involves diffusion, osmosis.

It is expressed in Pascals(Pa).

Water potential of Pure water is taken as zero at standard temperature and pressure.

Water potential has two main components (i) Solute potential and (ii) Pressure potential.

**i) Solute potential ( $\psi_s$ ):** When a solute is dissolved in pure water , the concentration of pure water decreases. Hence its water potential also decreases. This decrease in water potential is called solute potential. **It is always negative.**

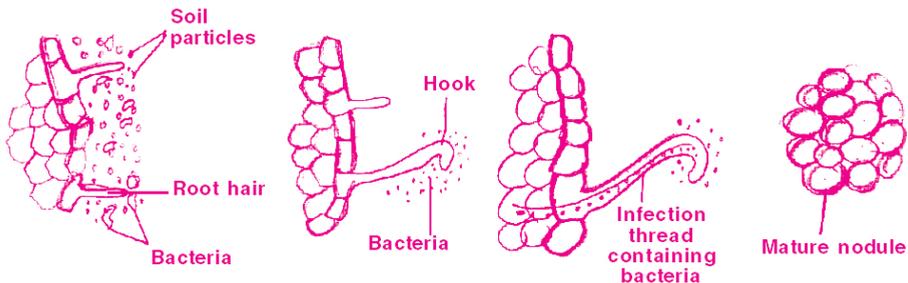
**ii) Pressure potential ( $\psi_p$ ):** When some water enters into a plant cell, the pressure against cell wall increases due to diffusion. This makes the cell turgid(swollen). This increase in water potential is called pressure potential. It is always positive. It is observed in the ascent of water through stem. Total water potential = Sum of solute & pressure potential.

$$\text{Total Water potential } \psi_w = \psi_s + \psi_p$$

### 13. Explain the steps involved in the formation of root nodule.

#### A: Steps involved in the formation of root nodule:

- 1) The roots of host Legume release sugars and amino acids.
- 2) These sugars attract Rhizobia.
- 3) They multiply, colonise and get attached to the epidermis of root hair cells.
- 4) The root hairs curl and bacteria spread into the cortex of the root.
- 5) Then an infection thread is produced.
- 6) It carries the bacteria into the cortex.
- 7) The bacteria initiate nodule formation in the cortex of the root.
- 8) Then the bacteria present in the cortical cells, stimulate the host cells to divide.
- 9) This leads to the differentiation of specialised nitrogen fixing cells, which form root nodule.
- 10) The nodule thus formed establishes a direct vascular connection with the host, for exchange of nutrients.

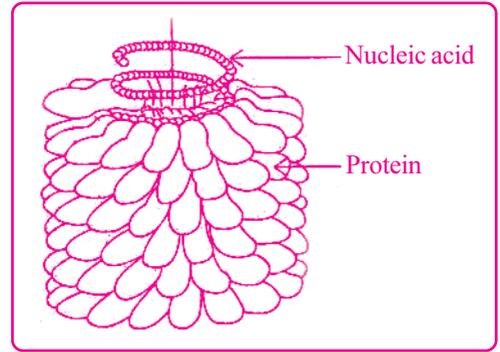


### 14. What are the physiological processes that are regulated by ethylene in plants.

- #### A:
- 1) Ethylene is a simple gaseous plant growth regulating (PGR) hormone.
  - 2) Ethylene effects horizontal growth of seedlings, swelling of axis and apical hook formation in dicot seedlings.
  - 3) Ethylene promotes senescence and abscission of leaves and flowers.
  - 4) **Ethylene is effective in fruit ripening.**
  - 5) Ethylene rises the rate of respiration and it is called respiratory climactic.
  - 6) Ethylene breaks seed and bud dormancy.
  - 7) Ethylene initiates germination in pea nut seeds and sprouting of potato tubers.
  - 8) In water plants, ethylene promotes rapid petiole and internode elongation.
  - 9) Ethylene also promotes growth of root and root hair formation.

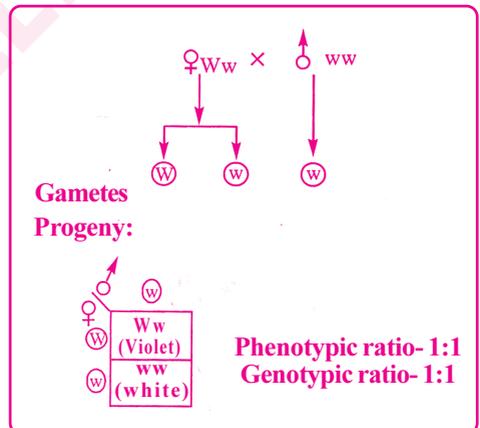
### 15. Explain the structure of TMV.

- A:**
- 1) **TMV stands for Tobacco mosaic virus.**
  - 2) TMV is a ssRNA virus that infects tobacco plants.
  - 3) Tobacco Mosaic Virus is a rod shaped virus. It is about **300 nm long and 18 nm in diameter**, with a molecular weight of  $39 \times 10^6$  Daltons.
  - 4) Its capsid is made of 2,130 proteins sub units called capsomeres.
  - 5) The capsomeres are arranged in a helical manner around a central hollow core of 4 nm.
  - 6) Each protein sub unit is made of 158 amino acids.
  - 7) Inside the capsid, there is single stranded spirally coiled RNA with 6,500 nucleotides.



### 16. Define and design a test-cross.

- A:**
- 1) **Test cross:** Crossing between  $F_1$  individuals with the **recessive parent** is called test cross.
  - 2) It is used to test whether an individual is homozygous or heterozygous.
  - 3) A **monohybrid** test cross gives a phenotype ratio of **1:1**
  - 4) A **dihybrid** test cross gives a ratio of **1:1:1:1**



### 17. What are the differences between DNA and RNA

<b>A:</b>	<b>DNA</b>	<b>RNA</b>
1)	DNA stands for Deoxyribo Nucleic Acid.	1) RNA stands for Ribo Nucleic Acid.
2)	DNA is double stranded Helix.	2) RNA is single stranded Helix.
3)	DNA is stable under alkaline condition.	3) RNA is unstable under alkaline condition.
4)	DNA contains the sugar Deoxyribose	4) RNA contains the sugar Ribose.
5)	DNA is made up of more than 4 million nucleotides.	5) RNA is made up of 75-2000 nucleotides.
6)	DNA undergoes self replication.	6) RNA does not undergo self replication.
7)	DNA is genetic material.	7) RNA is non-genetic material.
8)	DNA does not participate directly in protein synthesis.	8) RNA participates directly in protein synthesis.
9)	DNA is of one type (metabolically).	9) RNA is of three types (metabolically).
10)	The base pairing is $A \equiv T$ and $G \equiv C$	10) The base pairing is $A = U$ and $G \equiv C$

**18. Give a brief account of Bt cotton.**

- A:**
- 1) Bt cotton is a genetically modified organism (GMO) cotton variety, which produces an insecticide bollworm.
  - 2) Bt cotton is created by using some strains of a bacterium, *Bacillus thuringiensis* (Bt in short form)
  - 3) This bacterium produces proteins that kill certain insects such as lepidopterans (tobacco bud worm), coleopterans (beetles) and dipterans (flies, mosquitoes)
  - 4) Bt forms protein crystals during a particular phase of growth. These crystals contain a toxic insecticidal protein.
  - 5) Bt toxin protein exist as **inactive protoxins**, but once an insect ingests the inactive toxin, it is converted into an active form of toxin due to **alkaline pH** of the gut which solublises the crystals.
  - 6) The activated toxin binds to the surface of mid gut epithelial cells and create pores that cause cell swelling and lysis leading to death of an insect.
  - 7) Specific Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into several crop plants.
  - 8) Most Bt toxins are insect group specific. Hence, the toxin is coded by a gene named 'Cry'. For example, the protein encoded by the **genes Cry I Ac and Cry II Ab control the cotton bollworms and Cry I Ab controls corn borer.**

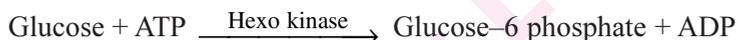
## SECTION-C

**19. Give an account of glycolysis. Where does it occur? What are the end products? Trace the fate of these products in both aerobic and anaerobic respiration. [or] Describe the process of various biochemical reactions that occur during Glycolysis.**

- A: 1) Glycolysis:** Glycolysis is the first step of **respiration** in all living organisms. It takes place in cytoplasm of cells. During Glycolysis, Glucose molecules break down to **release energy**. Glycolysis is the **partial oxidation** of one glucose molecule to form two molecules of pyruvic acid. The end products of Glycolysis are **pyruvic acid (PA), ATP, NADPH + H<sup>+</sup>**
- 2) Fate of Pyruvic acid:** In aerobic respiration, where oxygen is available, pyruvic acid will be completely oxidised into CO<sub>2</sub> and H<sub>2</sub>O by **Krebs cycle**.  
In anaerobic respiration, where oxygen is not available, pyruvic acid will be converted into Ethylalcohol or Lactic acid by **Fermentation**.  
Glycolysis involves a chain of '**10- step catalysed reactions**' by various enzymes.

### 3) Glycolysis Process:

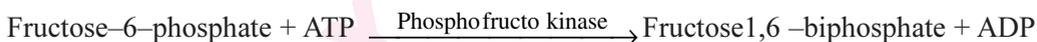
#### Step-1 (Phosphorylation):



#### Step-2 (Isomerisation):



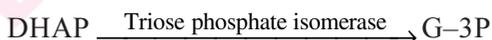
#### Step-3 (Phosphorylation):



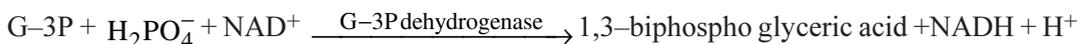
#### Step-4 (Cleavage):



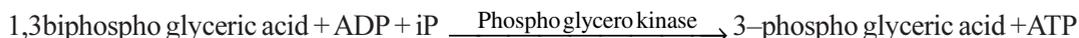
#### Step-5 (Isomerisation):



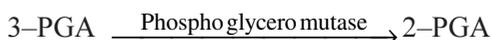
#### Step 6 (Oxidation) :



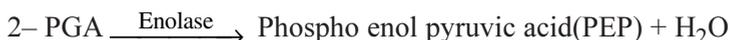
#### Step-7 (Dephosphorylation):



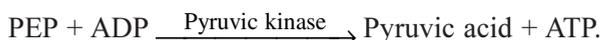
#### Step-8 (Intramolecular shift):



#### Step-9 (Dehydration):



#### Step-10 (Dephosphorylation):



**20. Explain briefly the various processes of recombinant DNA technology.****A: Processes of recombinant DNA technology:****1) Isolation of DNA:**

- (i) Nucleic acid is the genetic material of organisms in the form of DNA.
- (ii) It is enclosed by membranes and surrounded by other cellular constituents.
- (iii) By using enzymes like lysozyme, cellulose, the cell walls can be digested.
- (iv) The membranes, RNA, proteins can be removed by using powered detergents, ribonuclease.
- (v) By the addition of ethanol, the purified DNA is precipitated.
- (vi) The fine threads of DNA are separated by Spooling.

**2) Fragmentation of DNA:** The purified DNA is cut into a number of fragments by restriction enzymes. This process is called resolving enzyme digestion.

**3) Isolation of desired DNA fragments:** The fragments of DNA can be separated by agarose gel electrophoresis. Since DNA are negatively charged, they accumulate towards the anode and are extracted from the gel piece through elution technique. Fragments of DNA are isolated.

**4) Amplification of the desired gene by using PCR:** In polymerase chain reaction, multiple copies of desired DNA fragments are synthesized in **vitro**. Here two sets of primers and the enzyme DNA polymerase are used. In this process, 1 billion copies are made by using Taq polymerase in 30 cycles.

**5) Ligation of the DNA fragment into a vector:** This requires a vector DNA and source DNA.

- (i) These are cut with the same endonuclease to obtain sticky ends.
- (ii) Both are then ligated by mixing vector DNA, gene of interest and enzyme DNA ligase to form recombinant DNA.

**6) Insertion of rDNA into the host cell:** This can be done in several ways.

- (i) In heat shock method, rDNA can be forced into host cells by incubating the cells with rDNA on ice. This enables the bacteria to take up the rDNA.
- (ii) In micro injection method, the rDNA is directly injected into the nucleus of an animal cell.
- (iii) In gene gun method, cells are bombarded with high velocity microparticles of gold coated with DNA

**7) Obtaining the foreign gene product:** When alien DNA is inserted into a cloning vector, the alien DNA gets multiplied. The rDNA expresses itself to form desired products.

**8) Downstream processing:** After completion of the biosynthetic stage, the product has to be processed before it is ready for marketing as a finished product. The processes include separation and purification.

**21. Describe the tissue culture technique and what are the advantages of tissue culture over conventional method of plant breeding in crop improvement programmes?**

**A: I) Tissue Culture:** The technique of growing, culturing and maintaining cells, tissues and organs in vitro is known as tissue culture. It is based on the cellular totipotency.

**Plant tissue culture techniques:**

- 1) Preparation of nutrient culture medium.
- 2) Sterilization of the culture medium.
- 3) Preparation of explant.
- 4) Inoculation of explant.
- 5) Incubation for growth
- 6) Acclimatization of plantlets and transfer to pots.

**1) Preparation of nutrient culture medium:** The nutrient medium must provide a carbon source such as sucrose and also inorganic salts, vitamins, aminoacids and growth regulators like auxins, cytokinins etc.

**2) Sterilization of the culture medium.:** The culture medium is rich in nutrients and therefore attracts micro organisms. So the medium should be sterilised. Sterilisation is carried out in an autoclave for 15 min, at 121°C and 15 lb pressure.

**3) Preparation of explant:** Any living part of the plant such as root, stem etc which is used as inoculum is called explant.

**4) Inoculation of explants:** The transfer of explants onto the sterile medium is called inoculation. It is carried out in the laminar air-flow chamber.

**5) Incubation for growth:**

- i) The cultures are incubated for 3 to 4 weeks. During this period the cells of the explant absorb nutrients, grow and undergo repeated mitotic divisions. They produce an undifferentiated mass of cells known as callus.
- ii) Auxins and Cytokinins are added to the culture media, so that the callus is induced to produce organs like roots and shoots. This phenomenon is called **organogenesis**.
- iii) The explant develops an embryonic callus through embryogenesis, from which embryoids are produced.
- iv) Since, these embryoids develop from somatic tissues they are referred to as somatic embryos.

**6) Acclimatization of plantlets and transfer to pots:** The plants generated through organogenesis need to be acclimatized before they are transferred to pots.

**II) Advantages of Tissue Culture:**

- (1) More number of plants can be produced in a short time.
- (2) Virus diseases can be prevented by producing virus free plants.
- (3) Seedless plants can be multiplied
- (4) Female plants are selectively produced through tissue culture.
- (5) Somatic hybrids can be raised by tissue culture, where sexual hybridisation is not possible.
- (6) Tissue culture of medicinal plants produce high value products of industrial and medicinal importance.