

Previous IPE
SOLVED PAPERS

MARCH -2025 (TS)

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

1. What are pleomorphic bacteria? Give an example.
2. Define hydroponics.
3. Explain the role of the pink colour pigment in the root nodule of legume plants. What is it called?
4. Who proposed the Chromosome theory of Inheritance?
5. In a typical DNA molecule, the proportion of Thymine is 30% of the N bases. Find out the percentages of other N bases.
6. What are the components of a nucleotide?
7. Name any two artificially restructured plasmids.
8. What is green revolution? Who is regarded as Father of green revolution?
9. Name any two genetically modified crops.
10. Name a microbe used for statin production. How do statins lower blood cholesterol level?

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

11. Explain the structure and mechanism of opening and closing of stomata.
12. Explain the mechanism of enzyme action.
13. Tabulate eight differences between C₃ cycles and C₄ cycles.
14. Write any four physiological effects of cytokinins in plants.
15. Explain the structure of T-even bacteriophages.
16. Mention the advantages of selecting pea plant for experiment by Mendel.
17. Write briefly on nucleosomes.
18. List out the beneficial aspects of transgenic plants.

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

19. Explain the reactions of Krebs's cycle.
20. Explain briefly the various processes of recombinant DNA technology.
21. You are a Botanist working in the area of plant breeding. Describe the various steps that you will undertake to release a new variety.

IPE TS MARCH-2025

SOLUTIONS

SECTION-A

1. **What are pleomorphic bacteria? Give an example.** [TS 18,20,25][AP 17,25]

- 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.

2. **Define hydroponics.** [TS 23,24,25][MAR-14]

- A:** **Hydroponics:** It is the technique of growing plants in a specified nutrient solution.

3. **Explain the role of the pink colour pigment in the root nodule of legume plants. What is it called?** [AP 15][TS 15,25]

- A:** 1) The pink coloured pigment in the root nodules of legume plants is called "Leg-haemoglobin".
- 2) Its role is to protect the dinitrogenase enzyme, which is highly sensitive to oxygen.

4. **Who proposed the Chromosome theory of Inheritance?** [TS 20,22,25] [AP 17, 19,22]

- A:** Sutton and Boveri.

5. **In a typical DNA molecule, the proportion of Thymine is 30% of the N bases. Find out the percentages of other N bases.** [AP 15][TS 16,19,22,25]

- A:** Adenine 30%; Guanine 20%; Cytosine 20% (Total 70%)

6. **What are the components of a nucleotide?** [TS 17,18,25][AP 17,18,19,22]

- A:** **A nucleotide has 3 components:** Nitrogenbase, pentose sugar and phosphate molecule.

7. **Name any two artificially restructured plasmids.** [AP 22,24][TS 19,25]

- A:** 1) pBR 322 (after Boliver and Rodriguez). 2) pUC 19, 101 (after University of California)

8. What is green revolution? Who is regarded as Father of green revolution?

[TS 15,17,20,23]

- A:
- 1) The creation and utilisation of high yielding varieties in the field of agriculture, substantial and dramatic increase in agricultural production is called green revolution.
 - 2) **Norman Borlaug** is regarded as Father of green revolution.

9. Name any two genetically modified crops.

[TS 25]

A: **Two genetically modified crops:** Bt-cotton and Bt- brinjal.

10. Name a microbe used for statin production. How do statins lower blood cholesterol level?

[AP 15, 23] [TS 16,18,19,22,25]

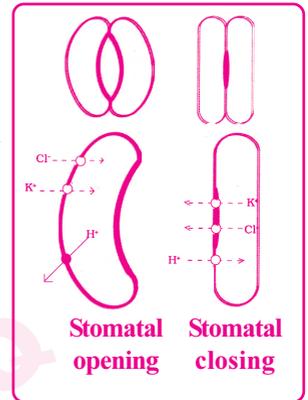
- A:
- 1) Microbe used for statin production is **Monascus purpureus** yeast.
 - 2) The statins lower blood cholesterol level by competitively inhibiting enzyme which is responsible for synthesis of cholesterol.

SECTION-B

11. Explain the structure and mechanism of opening and closing of stomata. [TS 15,24,25]

A: Levitt's K^+ ion pump theory :

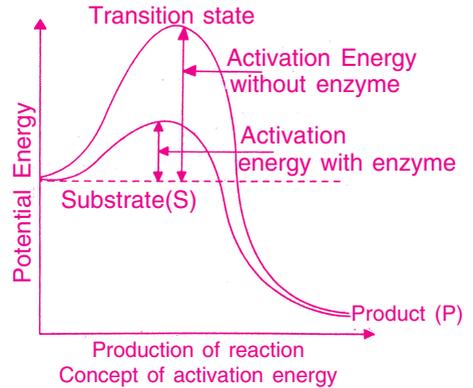
- 1) According to this theory, K^+ ions accumulate in the guard cells from the subsidiary cells in the presence of light.
- 2) This is coupled with efflux of protons which leads to an increase in the pH of guard cells.
- 3) This is also associated with passive influx of Cl^- ions, thereby decreasing the water potential of guard cells.
- 4) Water enters into guard cells, making them turgid.
- 5) The outer walls of guard cells are thin and expand outwardly, leaving a minute pore in the centre to open.
- 6) At night, in the absence of light, K^+ and Cl^- ions move out of guard cells, due to which the water potential of guard cells increases. Hence, water moves out and stomata closes.
- 7) Under water stress conditions Abscisic acid (ABA), drives the K^+ ions out of guard cells making them close.
- 8) In succulent plants, the water potential gradient is established. Accumulation of organic acids at night makes the guard cells turgid, hence stomata opens at night.



12. Explain the mechanism of enzyme action.

[TS MAR-25][AP MAR- 20]

- A:**
- 1) Each enzyme (E) has substrate (S) binding site in its molecule with in a given cleft.
 - 2) The substrate has to diffuse towards the active site leading to formation of enzyme substrate complex with in a short time .
 - 3) This transition state structure soon dissociates into enzyme product complex.
 - 4) The energy required for the substrate to get converted into products is called activation energy which is available from heat, ATP's etc.



- 5) The structure of substrate gets transformed into the structure of products.



- 6) When we represent this pictorially through a graph by taking potential energy on Y-axis and progress of reaction on X-axis, we notice the energy level difference between 'S' and 'P'.
- 7) If 'P' is at lower level than S, it is an exothermic reaction. One need not supply energy to form the product.
- 8) If 'P' has higher energy level then 'S' it is an endothermic or energy requiring reaction.
- 9) Then 'S' has to go through a much higher energy state or transition state.
- 10) Each enzyme E has a substrate (S) binding site in its molecule so that a highly reactive enzyme substrate complex (ES) is produced .

13. Tabulate any eight differences between C₃ and C₄ plants/cycles. [AP 15,17][TS 15,17,25]

A:

C ₃ Cycle	C ₄ Cycle
1) First stable product of carbon pathway is C ₃ compound (PGA-Phospho glyceric acid)	1) First stable product of carbon pathway is C ₄ compound (OAA-Oxalo acetic acid)
2) This occurs mostly in Temperate plants.	2) This occurs only in Tropical plants.
3) Leaves donot show Kranz anatomy.	3) Leaves show Kranz anatomy.
4) Chloroplast dimorphism is not seen.	4) Chloroplast dimorphism is seen.
5) Photo respiration is very high.	5) Photo respiration is not detectable.
6) In C ₃ plants, transpiration is more.	6) In C ₄ plants, transpiration is less.
7) Less efficient in utilising atmospheric CO ₂ .	7) More efficient in utilising atmospheric CO ₂ .
8) Biomass is produced in less quantity.	8) Biomass is produced in high quantity.
9) Ex: Almost all dicot plants	9) Ex: Maize, Sugarcane, Sorghum

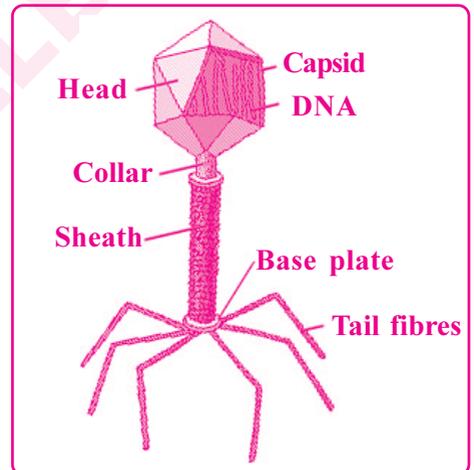
14. Write any four physiological effects of cytokinins in plants. [TS 19,25][AP 16,17]

- A:**
- 1) Cytokinins are a class of plant growth hormones that promote cell divisions in roots & shoot tips.
 - 2) They help to produce new leaves, chloroplasts in leaves.
 - 3) They help in lateral shoot growth and adventitious shoot formation.
 - 4) They promote nutrient metabolism which helps the delay of leaf senescence.
 - 5) They help to overcome apical dominance. Thus they promote the growth of lateral branches and help in the bushy growth of the tree.
 - 6) Naturally Cytokinins are synthesised in places where rapid cell division occurs.

Ex: Root tips, shoot buds, young fruits.

15. Explain the structure of T-even bacteriophages. [AP 17,19][TS 18,19,20,25]

- A:**
- 1) The viruses which attack bacteria are called bacteriophages.
 - 2) Bacteriophages are **tadpole-shaped**.
 - 3) The head is hexagonal and is capped by hexagonal pyramid.
 - 4) The tail is composed of a tail sheath, a base plate, pins and tail fibres.
 - 5) The tail helps injecting viral DNA into host cell.
 - 6) The head and tail are joined by collar.
 - 7) At the tip of the tail, hexagonal tail plate is present with six tail pins and tail fibres.
 - 8) With the help of tail fibres the virus attaches to the host cells.



16. Mention the advantages of selecting pea plant for experiment by Mendel.

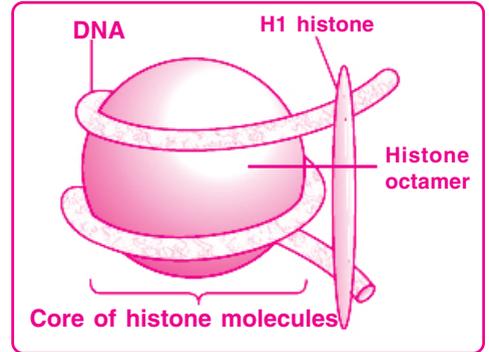
- A: Mendel selected garden pea for his experiments due to following advantages: [TS 19,20,22,25][AP 17,18,23]**
- 1) It has many contrasting characters.
 - 2) It can be grown and crossed easily.
 - 3) It has bisexual flowers containing both female and male flowers
 - 4) It can be self pollinated conveniently.
 - 5) It has a short life cycle and produces large number of off springs.
 - 6) It has less number of chromosomes
 - 7) It may be conducted in simple laboratory conditions.

17. Write briefly on nucleosomes.

[AP 17, 19][TS 22,25]

A: 1) Nucleosome is a bead like structure of chromosomes.

- 2) It consists of eight histone molecules (histone octamer) and a DNA segment of about 150 base pairs.
- 3) The negatively charged DNA is wrapped around the positively charged histone octamer to form the structure of nucleosome.
- 4) Nucleosome helps to fold DNA into a compact form.
- 5) DNA and basic histone proteins constitute chromatin.
- 6) Nucleosomes constitute the repeating unit of a structure in nucleus called chromatin.
- 7) The nucleosomes in chromatin are seen as 'beads-on-string' when viewed under electron microscope.



18. List out the beneficial aspects of transgenic plants. [TS 17,22,25] [AP 17,19,23,24]

A: Beneficial aspects of transgenic plants:

- 1) **Transgenic crop plants having resistance to pathogens and pests:**
 - (i) **Transgenic papaya** is resistant to **papaya ring spot virus**.
 - (ii) **Bt cotton** is resistant to **insects**.
 - (iii) **Transgenic tomato** plants are resistant to the **bacterial pathogen pseudomonas**.
 - (iv) **Transgenic potato** plants are resistant to the **fungus phytophthora**.
- 2) **Transgenic plants suitable for food processing technology:**
 - **Transgenic tomato "Flavr Savr"** is **bruise resistant** i.e., suitable for storage and transport due to delayed ripening.
- 3) **Transgenic plants with improved nutritional value:**
 - Transgenic golden rice obtained from "Taipei" is rich in **vitamin A** and **prevents blindness**.
- 4) **Transgenic plants used for hybrid seed production:**
 - Male sterile plants of Brassica napus are produced. This will eliminate the problem of manual emasculation and reduce the cost of hybrid seed production.
- 5) **Transgenic plants tolerant to abiotic stresses caused by chemicals, cold, drought, salt, heat etc:**
 - Basmati variety of rice was made resistant against biotic and abiotic stresses.
 - Round up ready **soyabean** is **herbicide tolerant**.

SECTION-C

19. Explain the reactions of Krebs cycle. [AP 16,17,19,19,22,23][TS 17,19,19,22,24,25]

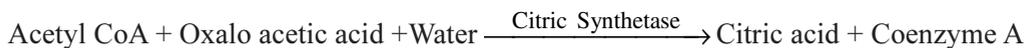
A: 1) Krebs Cycle: Krebs cycle is a cyclic process which occurs in all aerobic organisms to generate energy. It takes place in mitochondria.

2) In Krebs cycle, Acetyl coenzyme (CoA) is oxidised to form CO_2 and H_2O .

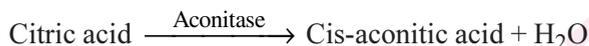
Also, ADP is converted into 'energy-rich' ATP.

3) Krebs Cycle- Reaction Steps:

Step 1 (Condensation):



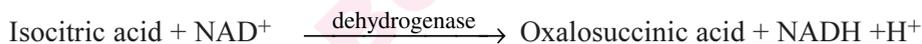
Step 2 (Dehydration):



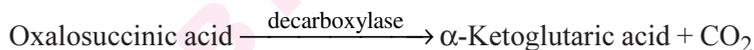
Step 3 (Hydration):



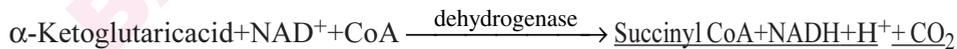
Step 4(Oxidation I):



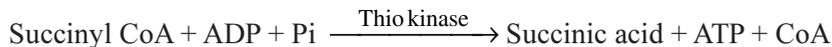
Step 5 (Decarboxylation):



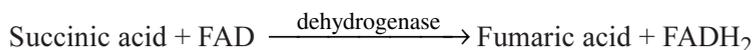
Step 6(Oxidation II):



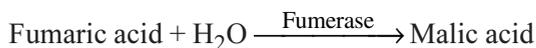
Step 7(Cleavage):



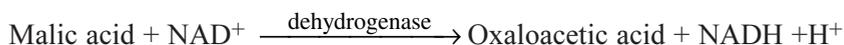
Step 8(Oxidation III):



Step 9(Hydration):



Step 10(Oxidation IV):



20. Explain briefly the various processes of recombinant DNA technology.

A: Processes of recombinant DNA technology:[AP 16,17, 19,22,24,25][TS 16,17,19,22,25]

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. You are a Botanist working in the area of plant breeding. Describe the various steps that you will undertake to release a new variety. [TS 16,17,25] [AP 17,24,24]

A: Various steps to release new genetic variety of crop are as follows:

- 1) Collection of variability.
- 2) Evaluation and selection of parents.
- 3) Cross hybridisation among the selected parents.
- 4) Selection and testing of superior recombinants.
- 5) Testing, release and commercialisation of new cultivars.

1) Collection of Variability:

- (i) Genetic variability is very important for any breeding programme.
- (ii) Pre-existing genetic variability is available from wild relatives of crop plants.
- (iii) Collection and preservation of all wild varieties, species is a pre-requisite for the effective exploitation of natural genes, available in the population.
- (iv) The entire collection of plants or seeds having all diverse alleles for all genes in a given crop is called germ plasm collection.

2) Evaluation and selection of parents:

- (i) Evaluation of germplasm is carried out, to identify plants with desirable characters.
- (ii) The selected plants are multiplied and used in hybridisation.
- (iii) Pure lines are created by self pollination.

3) Cross Hybridisation among the selected parents:

- (i) All the desired genetic characters are combined to form different parents.
- (ii) But cross Hybridisation is a time consuming and slow process.
- (iii) Also, it is not sure that all hybrids give desirable characters.
- (iv) Usually only one in a few hundred crosses, show desirable combination.

4) Selection and testing of superior recombinants:

- (i) Plants having desirable character combination are to be selected from the hybrids.
- (ii) This step yields off springs that are superior to both the parents.
- (iii) Continuous self pollination can achieve homozygosity.
- (iv) So that characters will not segregate in the progeny.

5) Testing, release and commercialisation of new cultivars:

- (i) The newly selected lines are evaluated for their yield and disease resistance.
- (ii) This evaluation is done by growing these plants in research fields.
- (iii) After evaluation, testing of hybrid line is done in farmer's field .
- (iv) The tested material is evaluated in comparison to the best available local crop cultivar.
- (v) The release of tested material is done after selection and certification.