Previous IPE

SOLVED PAPERS

MARCH-2023 (AP)

PREVIOUS PAPERS

IPE: MARCH-2023(AP)

Time: 3 Hours **SR BOTANY** **Max. Marks: 60**

SECTION-A

I. Answer ALL the following VSAQ: **10 × 2 = 20**

1. Explain the terms phenotype and genotype.
2. Give two examples of fungi used in SCP production.
3. Does transpiration occur at night? Give an example.
4. Distinguish between action spectrum and absorption spectrum.
5. What is conjugation? Who discovered it and in which organism?
6. What are the components of a transcription unit?
7. What is meant by capping and tailing?
8. What is the full form of PCR? How is it useful in biotechnology?
9. Give different types of cry genes and pests which are controlled by the proteins encoded by these genes.
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. Write the important features of Genetic code?
12. Write briefly about enzyme inhibitors.
13. Mention the advantages of selecting pea plant for experiment by Mendel.
14. List out the beneficial aspects of transgenic plants.
15. Explain the steps involved in the formation of root nodule.
16. What is meant by plasmolysis? How is it practically useful to us?
17. Which one of the plant growth regulators would you use if you are asked to
    a) Induce rooting in a twig
    b) Quickly ripen a fruit
    c) Delay leaf senescence
    d) Induce growth in axillary buds
    e) 'Bolt' a rosette plant
    f) Induce immediate stomatal closure in leaves
    g) Overcome apical dominance
    h) kill dicotyledonous weeds
18. What is ICTV? How are viruses named?

SECTION-C

II. Answer any TWO of the following SAQs: **2 × 8 = 16**

19. Describe the tissue culture technique and what are the advantages of tissue culture over conventional method of plant breeding in crop improvement programmes?
20. Explain the reactions of Kreb's cycle.
21. Give a brief account of the tools of recombinant DNA technology.

IPE AP MARCH-2023
SOLUTIONS

SECTION-A

1. Explain the terms phenotype and genotype. **[TS MAY-22][AP,TS MAY-17]**

A: 1) The physical appearance of a character is called Phenotype **[AP MAR-16,23]**

2) The genetic makeup of an individual is called Genotype.

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2. Give two examples of fungi used in SCP production. **[AP 15,17,23][TS 17]**

A: 1) Candida utilis (Torula Yeast)

2) Saccharomyces cerevisiae (Baker's yeast)

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3. Does transpiration occur at night? Give an example. **[AP 23]**

A: 1) Yes, transpiration occurs at night.

2) **Ex:** Bryophyllum, Cacti.

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4. Distinguish between action spectrum and absorption spectrum. **[AP MAR-16,23]**

A: **1) Action spectrum:** It is the graph showing the 'rate of photosynthesis' at different wave lengths.

2) Absorption spectrum: It is the graph showing the 'absorption of light' by pigments at different wave lengths.

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5. What is conjugation? Who discovered it and in which organism? **[AP 19, 17, 23]**

A: 1) **Conjugation:** It is the transfer of genetic material between two bacterial cells through direct contact.

2) It was discovered by Lederberg and Tatum in Escherichia Coli.

6. What are the components of a transcription unit? [TS 17, 17][AP 16,19,23]

A: The components of transcription unit are

a) A promoter b) The structural gene and c) A Terminator.

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7. What is meant by capping and tailing? [TS 16,23][AP 17,23]

A: 1) **Capping:** Adding of an unusual nucleotide (methyl guanosine triphosphate) to the 5'-end of hnRNA is called Capping.

2) **Tailing:** Adding of adenylate residues (200-300) to the 3'-end in a template is called tailing.

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8. What is the full form of PCR? How is it useful in biotechnology? [TS 15][AP 18,23]

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. Give different types of cry genes and pests which are controlled by the proteins encoded by these genes. [AP 23][TS 16]

A: 1) The proteins of Cry I Ac and Cry II Ab control the cotton boll worms.

2) The proteins of Cry I Ab controls corn borer.

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10. Name a microbe used for statin production. How do statins lower blood cholesterol level? [AP 15, 23] [TS 16,18,19,22]

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. Write the important features of Genetic code? [AP 16,17,18,22, 23][TS 15,18,19,22]

A: The important features of genetic code:

1) Genetic code is a set of instructions that direct the translation of DNA into 20 amino acids.
2) Genetic code consists of 64 triplets of Nucleotides. Each triplet is called a codon.
3) 61 codons code for amino acids. 3 codons donot code for any amino acids, hence they are called stop codons.
4) One codon codes for only one amino acid, hence it is unambiguous and specific.
5) Some amino acids are coded by more than one codon, hence the code is degenerate.
6) The codon is read in mRNA in a contiguous fashion. There are no punctuations.
7) The code is nearly universal.
8) **Ex:** From bacteria to human, UUU would code for phenylalanine (phe).

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12. Write briefly about enzyme inhibitors. [TS 17,17,19] [AP 17, 19,23]

A: Enzyme Inhibitors: These are the chemicals which2 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.

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

[TS 19,20,22][AP 17,18,23]

A: Mendel selected garden pea for his experiments due to following advantages:

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.

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

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.

15. Explain the steps involved in the formation of root nodule.

A: Steps involved in the formation of root nodule: [AP 17, 19,23][TS 16,17,20,23]

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.

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16. What is meant by plasmolysis? How is it practically useful to us? [AP 16, 23]

A: 1) Plasmolysis: It is the shrinkage of protoplast of cell due to loss of water and turgor.
2) This happens when a plant cell is placed in hypertonic solution.
3) Water molecules inside the cell move out into the solution.
4) Then the cell membrane shrinks away from its cell wall.
5) This causes the protoplast to shrink away from the wall.
6) This leads to the separation of plasma membrane from the cell wall.
7) Then the cell is said to be plasmolysed.
8) **Practical applications:** Salting of pickles, preservation of fish, meat and prawns.

17. Which one of the plant growth regulators would you use if you are asked to

a) Induce rooting in a twig **b) Quickly ripen a fruit**

c) Delay leaf senescence **d) Induce growth in axillary buds**

e) 'Bolt' a rosette plant **f) Induce immediate stomatal closure in leaves**

g) Overcome apical dominance **h) kill dicotyledonous weeds**

A: a) Auxins like IBA b) Ethylene c) Cytokinin

d) Cytokinin e) Gibberellins f) Abscisic acid (ABA)

g) Cytokinins h) 2,4 D(Auxin) **[AP 23]**

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18. What is ICTV? How are viruses named? **[AP 23] [TS 19,23]**

A: 1) **ICTV means – International Committee on Taxonomy of Viruses.**

2) It explains the classification and nomenclature of viruses.

3) ICTV has three hierarchial levels namely family, genus and species.

4) The family names end with the suffix Viridae

5) The genus names end with virus.

6) The species names are common english expressions describing their nature.

7) Sometimes viruses are named after the disease they cause. **Ex:** Polio virus.

8) According to ICTV, the virus that causes AIDS in man is classified as follows:

Family: Retroviridae, **Genes:** Lentivirus, **Species:** Human Immuno deficiency virus(HIV)

SECTION-C

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

[AP 15,16,17,19,19,20,22,23][TS 15,17,19,20]

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 121ºC 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 thie 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.

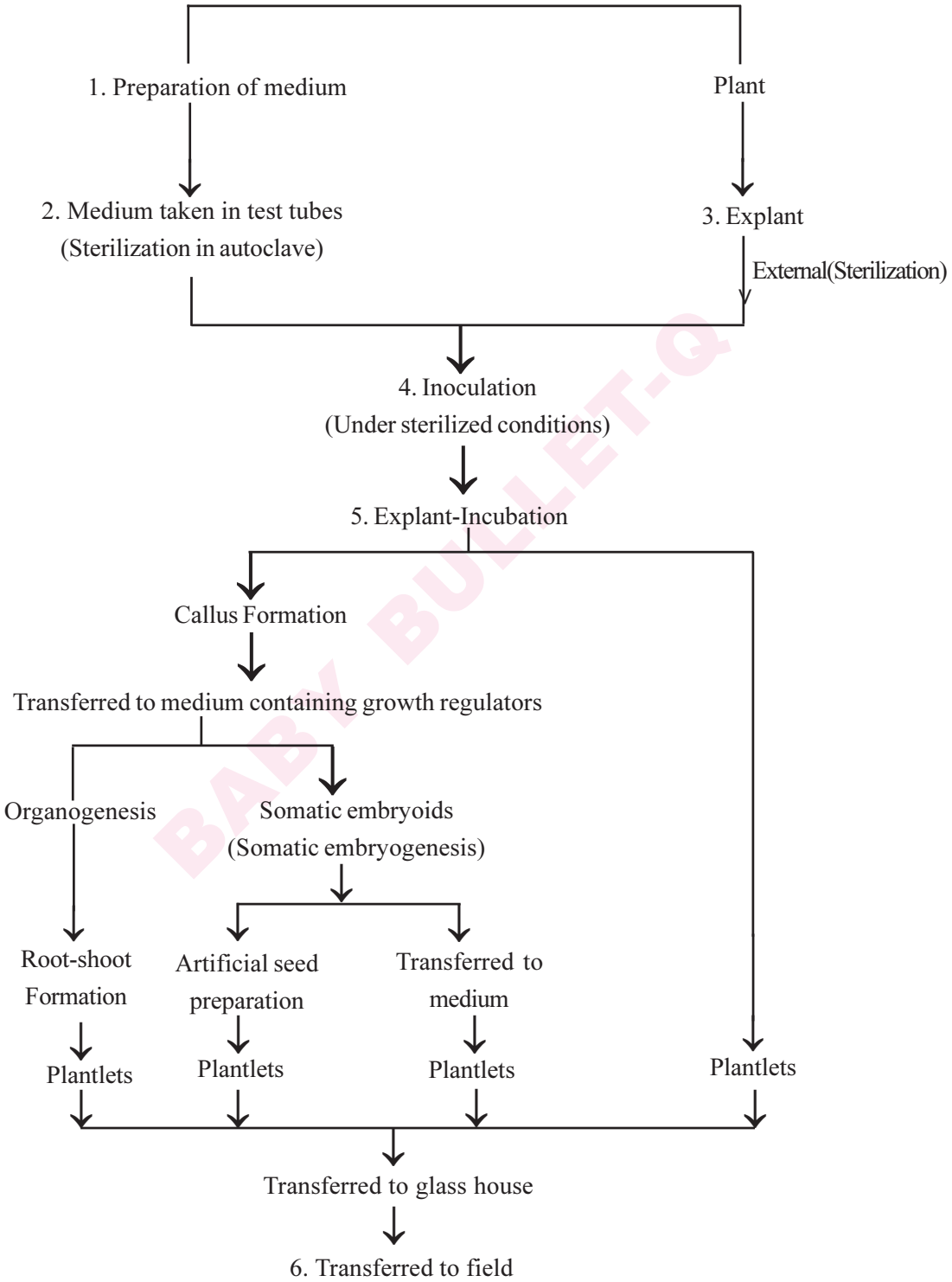
(iv)Since, these embryoids develop from somatic tissues they are referred to as somatic embryos.

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:

(i) More number of plants can be produced in a short time.
(ii) Virus diseases can be prevented by producing virus free plants from shoot-tip cultures.
(iii) Seedless plants can be multiplied
(iv) Female plants are selectively produced through tissue culture.
(v) Somatic hybrids can be raised by tissue culture, where sexual hybridisation is not possible.
(vi) Tissue culture of medicinal plants produce high value products of industrial and medicinal importance.

PLANT TISSUE CULTURE TECHNIQUE



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

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):

$$\text{Acetyl CoA + Oxalo acetic acid + Water} \xrightarrow{\text{Citric Synthetase}} \text{Citric acid + Coenzyme A}$$

Step 2 (Dehydration):

$$\text{Citric acid} \xrightarrow{\text{Aconitase}} \text{Cis-aconitic acid} + H_2O$$

Step 3 (Hydration):

$$\text{Cis-aconitic acid} \xrightarrow{\text{Aconitase}} \text{Isocitric acid}$$

Step 4(Oxidation I):

$$\text{Isocitric acid} + NAD^+ \xrightarrow{\text{dehydrogenase}} \underline{\text{Oxalosuccinic acid + NADH + H}^+}$$

Step 5 (Decarboxylation):

$$\text{Oxalosuccinic acid} \xrightarrow{\text{decarboxylase}} \alpha\text{-Ketoglutaric acid} + CO_2$$

Step 6(Oxidation II):

$$\alpha\text{-Ketoglutaricacid} + NAD^+ + CoA \xrightarrow{\text{dehydrogenase}} \underline{\text{Succinyl CoA + NADH + H}^+ + CO_2}$$

Step 7(Cleavage):

$$\text{Succinyl CoA + ADP + Pi} \xrightarrow{\text{Thio kinase}} \text{Succinic acid + ATP + CoA}$$

Step 8(Oxidation III):

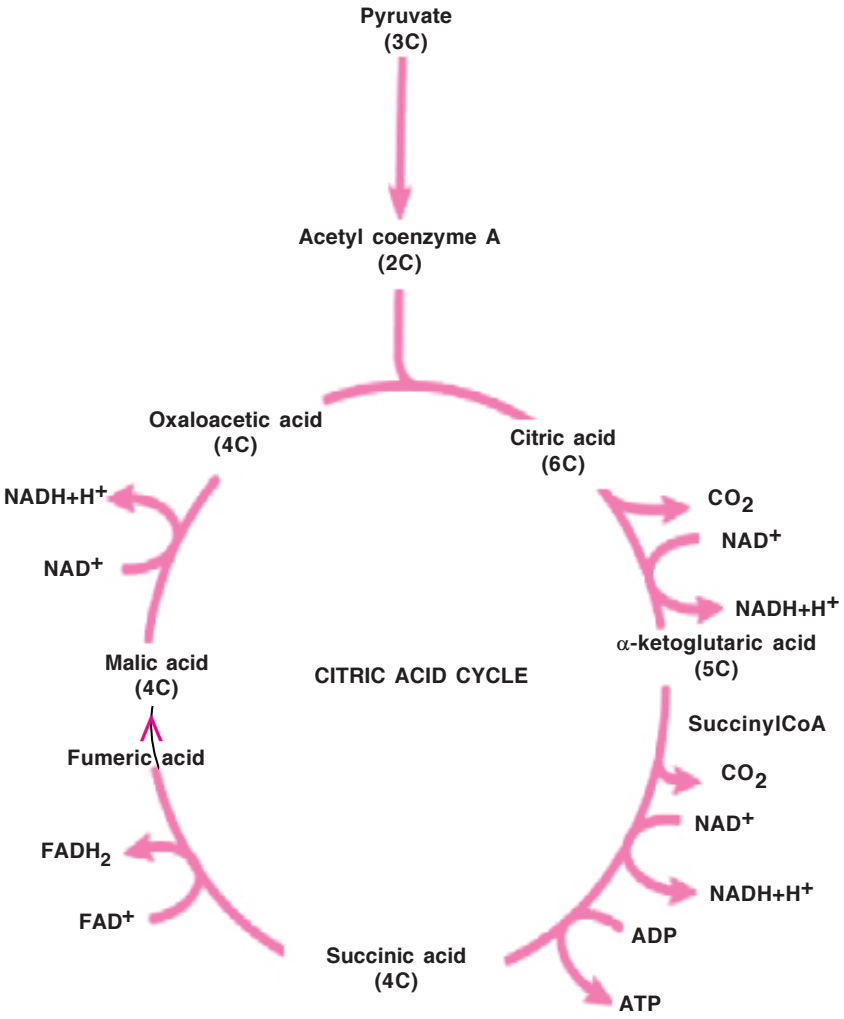
$$\text{Succinic acid} + FAD \xrightarrow{\text{dehydrogenase}} \text{Fumaric acid} + FADH_2$$

Step 9(Hydration):

$$\text{Fumaric acid} + H_2O \xrightarrow{\text{Fumerase}} \text{Malic acid}$$

Step 10(Oxidation IV):

$$\text{Malic acid} + NAD^+ \xrightarrow{\text{dehydrogenase}} \underline{\text{Oxaloacetic acid + NADH + H}^+}$$



KREB'S CYCLE

Kreb's Cycle

- ☺ It's the Second Step of Respiration
- ☺ It's Second IMP. LAQ
- ☺ It's a cyclic 'Q'.

21. Give a brief account of the tools of recombinant DNA technology.
[TS 17,19,20, 23][AP 15,17,19,20,23]

A: Tools of recombinant DNA technology:

1) Restriction enzymes 2) Polymerase enzymes 3) Ligases 4) Vectors 5) Host organism

1) Restriction enzymes: Restriction enzymes belong to a larger class of enzymes called nucleases. These are two kinds

(i) Exonucleases: Exonucleases remove nucleotides from the ends of the DNA

(ii) Endonucleases: Endonucleases make cuts at specific positions within the DNA.

Each restriction endonuclease recognises a specific palindromic sequence in the DNA.

The palindrome in DNA is a sequence of base pairs, that reads the same on the two strands

Ex: EcoRI recognises 5^1 GAATTC 3^1 sites on the DNA and cuts in between G and A

5^1 G A A T T C 3'

3^1 C T T A A G 5'

2) Polymerase enzymes:

(i) In polymerase chain reaction multiple copies of gene of interest are synthesized by using primers and DNA polymerase.

(ii) In this process the replication of DNA is repeated many times and 1 billion copies can be produced.

(iii) Such amplification is achieved by Taq polymerase which remain active at high temperatures.

(iv) The amplified fragment, if desired, can now be used to ligate with a vector for further cloning.

3) Ligases: The enzyme DNA ligase, joins the ends of plasmid DNA with that of desired gene by covalent bonding. It regenerates a circular hybrid called rDNA.

4) Vectors: The DNA used as a carrier, for transferring a fragment of foreign DNA, into a suitable host called vector.

(i) Vectors used for multiplying the foreign DNA sequences are called cloning vectors.

(ii) Commonly used cloning vectors are plasmids, bacteriophages, cosmids, BAC, YAC.

Properties of cloning vectors:

(i) They must have low molecular weight

(ii) They must have unique cleavage site for the activity of restriction sites.

(iii) They must be able to replicate inside the host cell after its introduction.

(iv) They require a 'selectable marker' which helps in identifying and eliminating non transformants.

5) Host organisms: Competent host for transformation with r-DNA is made by treating host with Ca^{+2} ions