BIO - BOTANY

HIGHER SECONDARY – SECOND YEAR

2023 – 24

T.PRABU

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Lesson - 1. Asexual and Sexual Reproduction in plants

1. Choose the correct statement from the following
   a) Gametes are involved in asexual reproduction
   b) Bacteria reproduce asexually by budding
   c) Conidia formation is a method of sexual reproduction
   d) Yeast reproduce by budding
2. An eminent Indian embryologist is
   a) S.R.Kashyap b) P.Maheswari c) M.S. Swaminathan d) K.C.Mehta
3. Identify the correctly matched pair
   a) Tuber - Allium cepa b) Sucker – Pistia
   c) Rhizome – Musa d) Stolon - Zingiber
4. Size of pollen grain in Myosotis
   a) 10 micrometer b) 20 micrometer
   c) 200 micrometer d) 2000 micrometer
5. First cell of male gametophyte in angiosperm is
   a) Microspore b) megaspore c) Nucleus d) Primary Endosperm nucleus
7. Match the following

	I	II	III	IV
(a)	Iv	I	ii	iii
(b)	Iii	Iv	i	ii
(c)	Iii	Iv	ii	i
(d)	Iii	I	iv	ii

I)	External fertilization	i)	pollen grain
II)	Androecium	ii)	anther wall
III)	Male gametophyte	iii)	algae
IV)	Primary parietal layer	iv)	stamens

8. Arrange the layers of anther wall from locus to periphery
   a) Epidermis, middle layers, tapetum, endothecium
   b) Tapetum, middle layers, epidermis, endothecium
   c) Endothecium, epidermis, middle layers, tapetum
   d) Tapetum, middle layers, endothecium, epidermis.
9. Identify the incorrect pair
   a) sporopollenin - exine of pollen grain
   b) tapetum – nutritive tissue for developing microspores
   c) Nucellus – nutritive tissue for developing embryo
   d) obturator – directs the pollen tube into micropyle
10. Assertion : Sporopollenin preserves pollen in fossil deposits
    Reason : Sporopollenin is resistant to physical and biological decomposition
    a) Assertion is true; reason is false b) Assertion is false; reason is true
    c) Both Assertion and reason are not true d) Both Assertion and reason are true.
11. Choose the correct statement (s) about tenuinucellate ovule
    a) Sporogenous cell is hypodermal b) Ovules have fairly large nucellus
    c) Sporogenous cell is epidermal d) ovules have single layer of nucellus tissue
12. Which of the following represent mega gametophyte
    a) Ovule b) Embryo sac c) Nucellus d) Endosperm
13. In Haplopappus gracilis, number of chromosomes in cells of nucellus is 4. What will be the chromosome number in Primary endosperm cell?
    a) 8 b) 12 c) 6 d) 2
14. Transmitting tissue is found in
    a) Micropylar region of ovule b) Pollen tube wall
    c) Stylar region of gynoecium d) Integument

15. The scar left by funiculus in the seed is
    a) tegmen b) radicle c) epicotyls d) hilum
16. A Plant called X possesses small flower with reduced perianth and versatile anther. The probable agent for pollination would be
    a) water b) air c) butterflies d) beetles
17. Consider the following statement (s)
    i) In Protandrous flowers pistil matures earlier
    ii) In Protogynous flowers pistil matures earlier
    iii) Herkogamy is noticed in unisexual flowers
    iv) Distyly is present in Primula
    a) i and ii are correct b) ii and iv are correct
    c) ii and iii are correct d) i and iv are correct
18. Coelorhiza is found in
    a) Paddy b) Bean c) Pea d) Tridax
19. Parthenocarpic fruits lack
    a) Endocarp b) Epicarp c) Mesocarp d) seed
20. Majority of plants pollen is liberated at
    a) 1 celled stage b) 2 celled stage c) 3 celled stage d) 4 celled stage

2, 3, 5 Marks Questions

1. What is reproduction?

- Reproduction is a vital process for the existence of a species.
- It brings suitable changes through variation in off springs.
- Plant reproduction is important for the existence of all other organisms.

2. List out two sub-aerial stem modifications with example.

- Runner - Centella asiatica
- Stolon - Mentha, Fragaria
- Offset - Pistia, and Eichhornia
- Sucker - Chrysanthemum.

3. What is layering?

- The stem of a parent plant is allowed to develop roots while still intact.
- When the root develops, the rooted part is cut and planted to grow as a new plant.
- Examples: Ixora and Jasminum.

4. What are clones?

- The individual formed by asexual method is morphologically and genetically identical and are called clones.

5. A detached leaf of Bryophyllum produces new plants. How?

- In Bryophyllum, the leaf is succulent and notched on its margin.
- Adventitious buds developed from these notches and are called epiphyllous buds.
- They develop into new plants forming a root system.
- They become independent plants when the leaf gets decayed.

6. Differentiate Grafting and Layering.

	Grafting	Layering.
1.	Two different plants are involved.	Only parent plant is involved.
2.	Parts of two different plants are united artificially to form a new plant. Plant in soil is called stock. The plant used for grafting is called scion.	The stem of the parent plant is allowed to develop roots while still intact. When the root develops, rooted part is cut and planted to grow as new plant.
3.	Ex : Citrus, Mango and Apple	Ex : Ixora

7. "Tissue culture is the best method for propagating rare and endangered plant species"- Discuss.

- Yes. Tissue culture is the best method of propagating rare and endangered plant species.

8. Explain the conventional methods adopted in vegetative propagation of higher plants.

Cutting

- Plant parts like root, stem, and leaf are cut from the parent plant.
- The Cut part is placed in a suitable medium.
- It produces root and grows into new plant.
- Ex : Hibiscus

Grafting

- Two different plants are involved.
- Parts of two different plants are united artificially to form a new plant.
- The Plant in soil is called stock. The plant used for grafting is called scion.
- Ex : Citrus, Mango and Apple.

Types

- Bud grafting
- Approach grafting
- Tongue grafting
- Crown grafting.

Layering

- The stem of the parent plant is allowed to develop roots while still intact.
- When the root develops, rooted part is cut and planted to grow as new plant.
- Ex : Ixora.

Types

- Mound layering
- Air layering.

S.No	Mound layering	Air layering
1.	The lower branch with leaves is bent to the ground and part of the stem is buried in the soil and tip of the branch is exposed above the soil.	The stem is girdled at nodal region and hormones are applied to this region which promotes rooting.
2.	In the buried nodal region root develops and a cut is made in parent plant to separate the buried part.	In the covered nodal region roots develop after 2 – 4 months. Then the branch is removed from the parent plant.
3.	Hormones are not required to promote rooting.	Hormones are applied to promote rooting.

9. Distinguish mound layering and air layering.

S.No	Mound layering	Air layering
1.	The lower branch with leaves is bent to the ground and part of the stem is buried in the soil and tip of the branch is exposed above the soil.	The stem is girdled at nodal region and hormones are applied to this region which promotes rooting.
2.	In the buried nodal region root develops and a cut is made in parent plant to separate the buried part.	In the covered nodal region roots develop after 2 – 4 months. Then the branch is removed from the parent plant.
3.	Hormones are not required to promote rooting.	Hormones are applied to promote rooting.

10. What is Cantharophily ?

- Pollination by beetle is called Cantharophily.

11. List any two strategy adopted by bisexual flowers to prevent self-pollination.

Dichogamy

- In bisexual flowers anthers and stigmas mature at different times.
  - **Protandry** : The stamens mature earlier than the stigmas of the flowers.
  - **Protogyny :** The stigmas mature earlier than the stamens of the flower

Herkogamy

- In bisexual flowers, the stamens and stigmas are arranged different positions.

12. What is endothelium?

- The inner layer of the integument may become specialized to perform the nutritive function for the embryo sac and is called as endothelium or integumentary tapetum.
- Ex : Asteraceae .

13."The endosperm of angiosperm is different from gymnosperm". Do you agree. Justify your answer.

- Yes I agreed.

Endosperm of angiosperm	Endosperm of gymnosperm
It is a triploid tissue.	It is a haploid tissue.
It is formed after fertilization.	It is formed before fertilization
Nourish the developing embryo.	It acts as the female gametophyte and nutritive tissue.

14. Define the term Diplospory.

- A diploid embryo sac is formed from megaspore mother cell without a regular meiotic division is called diplospory.
- Ex : Eupatorium and Aerva.

15. What is polyembryony. How it can commercially exploited?

- Presence of more than one embryo in a seed is called polyembryony.

Commercially exploited

- The seedlings formed from the nucellar tissue in Citrus are found better clones for Orchards.
- Embryos derived through polyembryony are found virus free.

16. Why does the zygote divides only after the division of Primary endosperm cell?

- The priary endosperm cells divides and generate the endosperm tissue which nourishes the zygote.
- So the zygote always divides after the division of Primary endosperm cell.

17. What is Mellitophily ?

- Pollination by Bees is called Mellitophily**.**

18. "Endothecium is associated with dehiscence of anther" Justify the statement.

- Endothecium is a single layer of radially elongated cells below the epidermis of anther wall.
- The cells along the junction of the two sporangia of an anther lobe lack these thickening and this region is called stomium.
- This region along with the hygroscopic nature of endothecium helps in the dehiscence of anther at maturity.

19. List out the functions of tapetum.

- It supplies nutrition to the developing microspores
- It contributes sporopollenin through ubisch bodies thus plays an important role in pollen wall formation.
- The pollenkitt material is contributed by tapetal cells and is later transferred to the pollen surface.
- Exine proteins responsible for rejection reaction of the stigma are present in the cavities of the exine.
- These proteins are derived from tapetal cells.

20. Write short note on Pollen kitt.

- It is an oily layer forming a thick viscous coating over pollen surface.
- Pollenkitt is yellow or orange coloured and is chiefly made of carotenoids or flavonoids.
- It attracts insects and protects damage from UV radiation.
- Pollenkitt is contributed by the tapetum.

21. Distinguish tenuinucellate and crassinucellate ovules.

	Tenuinucellate type	crassinucellate type
1.	The sporogenous cell is hypodermal with a single layer of nucellar tissue.	Ovules with sub hypodermal sporogenous cell.
2.	Normally ovules have very small nucellus.	Normally these ovules have fairly large nucellus.

22. 'Pollination in Gymnosperms is different from Angiosperms' – Give reasons.

Gymnosperms	Angiosperms
Direct pollination	Indirect pollination
In gymnosperms the pollens are deposited directly on the exposed ovules.	In angiosperms the pollens are deposited on the stigma of the pistil.

23. Write short note on Heterostyly.

- Some plants produce two or three different forms of flowers.
- They are different in length of stamens and style.
- Pollination will take place only between organs of the same length.

24. Enumerate the characteristic features of Entomophilous flowers.

- Flowers are generally large.
- If small they are aggregated in dense inflorescence. Ex: Asteraceae flowers.
- Flowers are brightly coloured to attract insects. ex : Poinsettia and Bougainvillea
- Flowers are scented and produce nectar.
- Pollen and nectar are the floral rewards for the visitors.
- Flowers pollinated by flies and beetles produce foul odour to attract pollinators
- In some flowers juicy cells are present which are pierced and the contents are sucked by the insects.

25. Discuss the steps involved in Microsporogenesis.

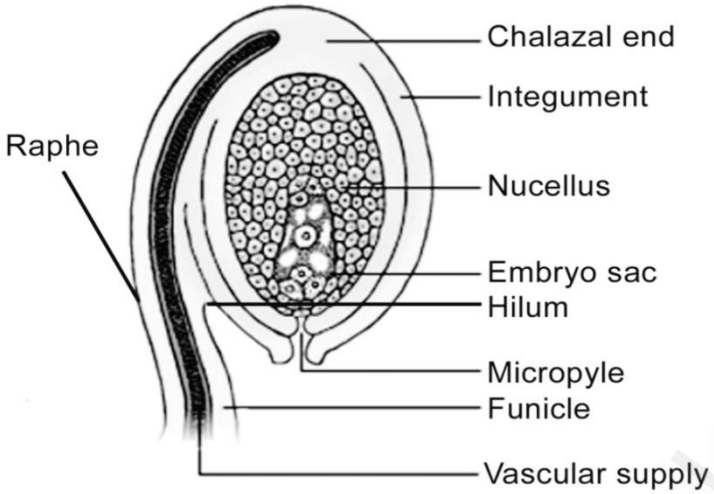
- The formation of haploid microspores (n) from diploid microspore mother cell (2n) by meiosis is called Microsporogenesis.

The steps involved in Microsporogenesis

- The primary sporogeneous cells directly mitotic divisions to form sporogenous tissue.
- The last generation of sporogenous tissue functions as microspore mother cells.
- Each microspore mother cell divides meiotically to form a tetrad of four haploid microspores.
- Microspores soon separate free in the anther locule and develop into pollen grains.
- All microspores in a microsporangium remain held together called pollinium.
- Ex: Calotropis.

26. With a suitable diagram explain the structure of an ovule.

- Ovule is also called megasporangium.
- It is protected by one or two covering called integuments.
- A mature ovule consists of a two parts
  - Stalk
  - Body
- The stalk or the funiculus is present at the base and attaches the ovule to the placenta.
- The point of attachment of funicle to the body of the ovule is known as hilum.
- The funicle is adnate to the body of the ovule forming a ridge called raphe.
- The body of the ovule is made up of a central mass of parenchymatous tissue known as nucellus.
- It has large reserve food materials.
- The nucellus is enveloped by one or two protective coverings called integuments.
- Integument encloses the nucellus except at the top and forms a pore called micropyle.
- The ovule with one integument said to be unitegmic or two integuments are said to be bitegmic.
- The nucellus, the integument and the funicle meet at the basal region of the ovule is called as chalaza.
- The micropylar end of the nucellus contains large oval, sac-like structure called embryo sac or female gametophyte.
- It develops from the functional megaspore formed within the nucellus.
- The inner layer of the integument may become specialized to perform the nutritive function for the embryo sac and is called as endothelium or integumentary tapetum.
- Ex : Asteraceae



27. Give a concise account on steps involved in fertilization of an angiosperm plant.

- The fusion of male and female gamete is called **fertilization**.
- Fertilization in angiosperms is double fertilization.

Events of fertilization

- Germination of pollen to form pollen tube in the stigma
- Growth of pollen tube in the style
- Direction of pollen tube towards the micropyle of the ovule
- Entry of the pollen tube into one of the synergids of the embryo sac.
- Discharge of male gametes
- One male gametes fuses with the egg to form Zygote – Syngamy.
- Second male gamete fuses with the polar nuclei and forms the primary endosperm nucleus (PEN) this phenomenon is called double fertilization.

28. Differentiate the structure of Dicot and Monocot seed.

	Dicot seed.	**Monocot seed.**
1.	The seed encloses two cotyledons	The seed encloses single cotyledon
2.	Coleoptile are absent	Coleoptile are present
3.	coleorhiza are absent	coleorhiza are present
4.	Scutellum is absent	Scutellum is present
5.	Suspensor is long	Suspensor is short
6.	Ex : Cicer arietinum	Ex : Oryza sativa

29. Give a detailed account on parthenocarpy. Add a note on its significance

- Formation of fruit from the ovary without fertilization is called parthenocarpic fruits.
- They fruits does not have true seeds.
- Ex : Banana, Grapes and Papaya.

Types of Parthenocarpy

- Genetic Parthenocarpy
- Environmental Parthenocarpy
- Chemically induced Parthenocarpy.

Significance parthenocarpic fruits

- The seedless fruits have great significance in horticulture.
- The seedless fruits have great commercial importance.
- They are useful for the preparation of jams, jellies, sauces, fruit drinks.
- High proportion of edible part is available in parthenocarpic fruits due to the absence of seeds.

30. What is endosperm? Explain the types.

- The primary endosperm nucleus (PEN) divides immediately after fertilization into an endosperm.
- Depending upon the mode of development three types of endosperm in angiosperms they are
  - Nuclear endosperm
  - Cellular endosperm
  - Helobial endosperm

Nuclear endosperm

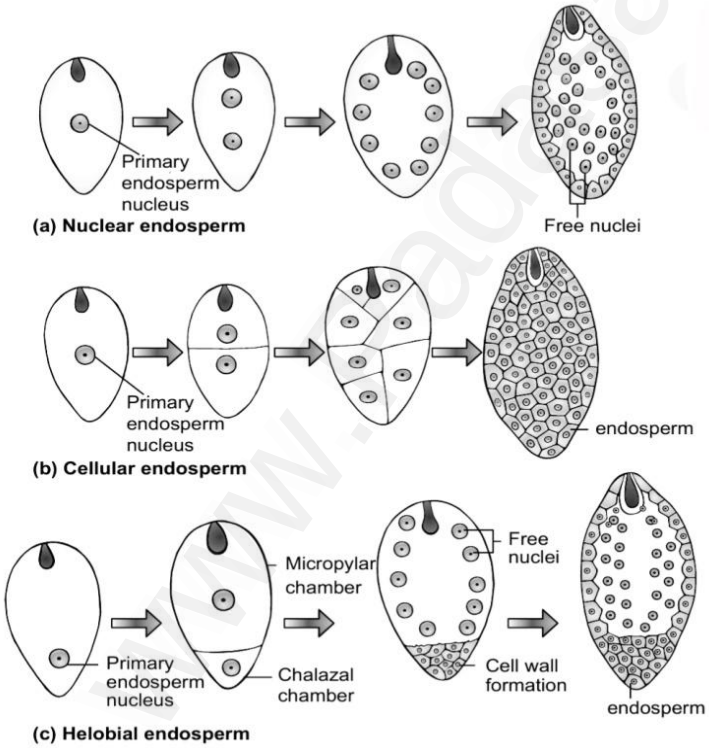
- Primary Endosperm Nucleus undergoes several mitotic divisions without cell wall formation.
- Thus a free nuclear condition exists in the endosperm.
- Ex : Coccinia, Capsella, Arachis

Cellular endosperm

- Primary endosperm nucleus divides into 2 nuclei and it is immediately followed by wall formation.
- Subsequent divisions also follow cell wall formation.
- Ex : Adoxa, Helianthus, Scoparia

Helobial endosperm

- Primary Endosperm Nucleus moves towards base of embryo sac and divides into two nuclei.
  - large micropylar chamber.
  - small chalazal chamber.
- The nucleus of the micropylar chamber undergoes several free nuclear division.
- The chalazal chamber may or may not divide.
- Ex : Hydrilla, Vallisneria.



Additional Questions

31. How do dioscorea reproduce vegetatively ?

- Dioscorea reproduces vegetatively by means of bulbils.

32. Write short notes on approach grafting.

- Both the scion and stock remain rooted.
- The stock is grown in a pot and it is brought close to the scion.
- Both of them should have the same thickness.
- A small slice is cut from both and the cut surfaces are brought near and tied together and held by a tape.
- After 1-4 weeks the tip of the stock and base of the scion are cut off and detached. and grown in a separate pot.

33. Enumerate the advantages of conventional methods of propagation

- The plants Produced genetically uniform.
- Plants are produced quickly.
- Some plants produce little or no seed. The seeds produced do not germinate.
- Plants can be produced in a short period.
- More economic propagation
- Ex : Solanum tuberosum.
- Grown a new plant with the same desirable characters.

34. Name the cell which divides to form male nuclei.

- Generative cells of microspore.

35. How does pollination occur in bee orchid?

- In Bee orchid (ophyrus) the morphology of flower is similar to female wasp (colpa).
- Male wasp mistakes the flower for female wasp, and tries to copulate.
- This pseudocopulation helps in pollination.

36. What is microsporogenesis ?

- The formation of haploid microspores (n) from diploid microspore mother cell (2n) through meiosis is called Microsporogenesis.

37. Differentiate secretory and invasive tapetum.

Secretory tapetum (parietal / glandular / cellular)

- The tapetum retains the original position and cellular integrity and nourishes the developing microspores.

Invasive tapetum (periplasmodial)

- The cells loose their inner tangential and radial walls and the protoplast of all tapetal cells coalesces to form a periplasmodium.

38. Tapetum is dual in origin – Justify your answer

- It is the innermost layer of anther wall.
- Tapetum is derived partly from the peripheral wall layer and partly from the connective tissue of the anther locule.
- Thus, the tapetum is dual in origin.

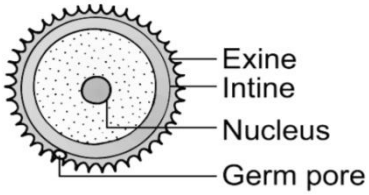
39. Describe pollinium.

- All microspores in a microsporangium remain held together called pollinium.
- Ex: Calotropis.

40. What is stomium ?

- The cells along the junction of the two sporangia of an anther lobe lack these thickenings this region is called stomium.

41. Draw a structure of pollengrains and label its parts.



42. What are the layers of anther wall?

- Epidermis
- Endothecium
- Middle layers
- Tapetum.

43. What is meant by cryopreservation?

- The technique is used to store pollen grains.
- Pollen is preserved in liquid nitrogen (-196^{o}c) in viable condition for prolonged duration. It is called cryopreservation.

44. What do you know about pollen robbers?

- Many visitors consume pollen and nectar and do not help in pollination they are called pollen robbers.

45. Explain the structure of mature anther.

- The mature anther wall consists of the following layers
  - Epidermis
  - Endothecium
  - Middle layers
  - Tapetum.

Epidermis

- It is single layered and protective in function.
- The cells undergo repeated anticlinal divisions to cope up with the rapidly enlarging internal tissues.

Endothecium:

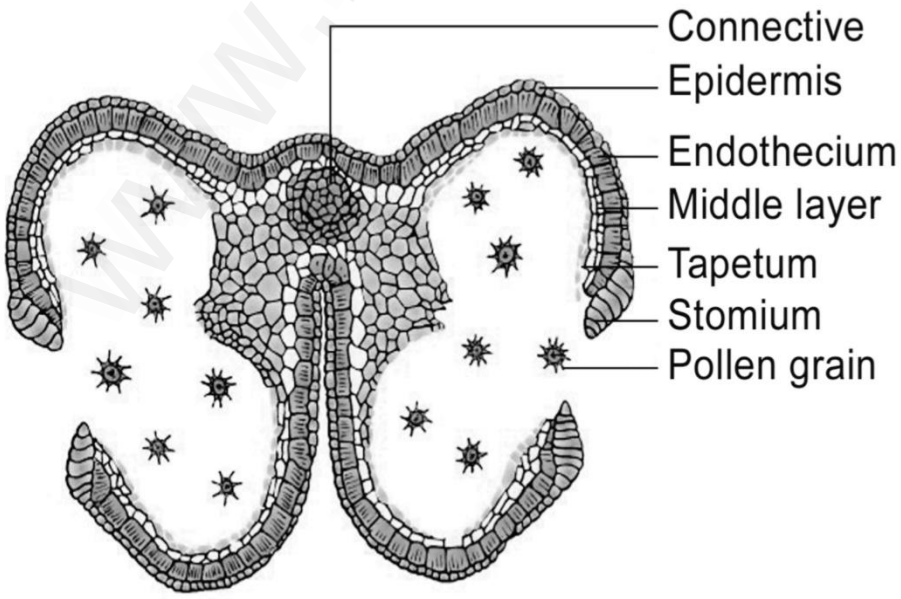
- It is found below the epidermis
- The inner tangential wall develops bands of cellulose.
- The hygroscopic nature of endothecium helps in the dehiscence of anther at maturity.

Middle layers

- Two to three layers of cells next to endothecium constitute middle layers.
- They are generally ephemeral. They disintegrate or get crushed during maturity.

Tapetum:

- It is the innermost layer of anther wall.
- It is derived partly from the peripheral wall layer and partly from the connective tissue of the anther lining the anther locule. Thus, the tapetum is dual in origin
- It attains maximum development at the tetrad stage of microsporogenesis.



46. Differentiate Intine and Exine.

Exine	Intine
Outer layer called exine.	Inner layer called intine
Exine is made up of cellulose, sporopollenin and pollenkitt.	Intine is made up of pectin, hemicellulose, cellulose and callose together with proteins.
Thick walled and not uniform.	Thin walled and uniform.

47. Give short notes on types of ovules.

- The ovules are classified into six main types. they are

Orthotropous

- The micropyle is at the distal end.
- The micropyle, the funicle and the chalaza lie in one straight vertical line.
- Ex : Piperaceae, Polygonaceae.

Anatropous

- The body of the ovule completely inverted.
- The micropyle and funiculus come to lie very close to each other.
- Ex : Dicots and monocots.

Hemianatropous

- The body of the ovule is placed transversely and at right angles to the funicle.
- Ex: Primulaceae.

Campylotropous

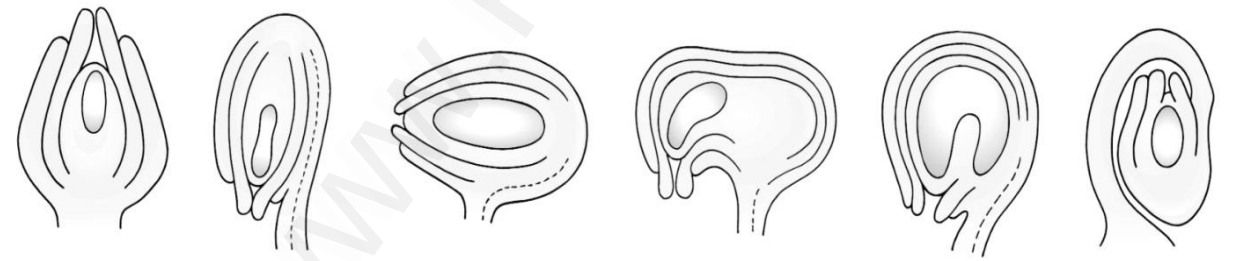
- The body of the ovule at the micropylar end is curved and more or less bean shaped.
- The embryo sac is slightly curved.
- Hilum, micropyle and chalaza are adjacent to one another.
- Ex : Leguminosae

Amphitropous

- The distance between hilum and chalaza is less.
- The curvature of the ovule leads to horse - shoe shaped nucellus.
- Ex : some Alismataceae.

Circinotropous

- Funiculus is very long and surrounds the ovule.
- Ex : Cactaceae.



(a) Orthotropous (b) Anatropous (c) Hemianatropous (d) Campylotropous (e) Amphitropous (f) Circinotropous

48. Define : Double fertilization

- In angiosperms, one of the male gametes fuses with the egg to form Zygote.
- Second male gamete fuses with the polar nuclei and forms the primary endosperm nucleus (PEN)
- So, this phenomenon is called double fertilization.

49. What is obturator ?

- The pollen tube after travelling the whole length of the style enters into the ovary locule.
- It is guided towards the micropyle of the ovule by a structure called obturator.

50. Explain the different mode of entry of pollen tube into the ovule.

- There are three types of pollen tube entry into the ovule.

Porogamy

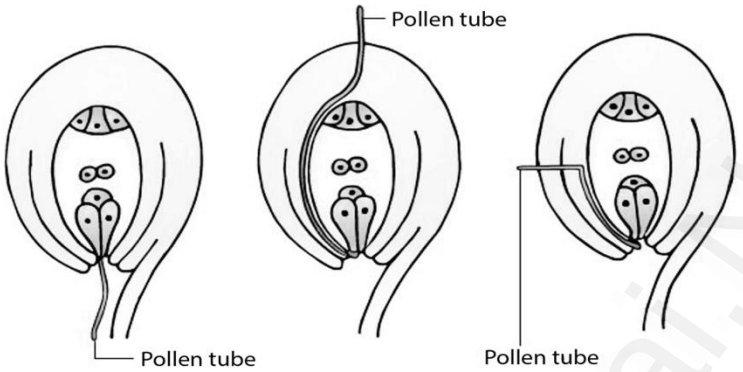
- When the pollen tube enters through the micropyle.

Chalazogamy

- The pollen tube enters through the chalaza.

Mesogamy

- When the pollen tube enters through the integument.



51. Define : perisperm.

- The nucellar tissue is absorbed completely by the developing embryo sac and embryo.
- The remnant of nucellar tissue in the seed is called perisperm.
- Ex : Black pepper and beet root

52. Tabulate post fertilization changes in a flower.

S.NO	Parts before fertilization	Transformation after fertilization
1.	Sepals, petals stamens, and stigma	Usually wither and fall off
2.	Ovary	Fruit
3.	Ovule	Seed
4.	Egg	zygote
5.	Funicle	Stalk of the seed
6.	Micropyle	Micropyle of the seed
7.	Nucellus	Perisperm
8.	Outer integument	Testa (Outer seed coat)
9.	Inner integument	Tegman (Inner seed coat)
10	Synergid cells	Degenerate
11.	Secondary nucleus	Endosperm
12.	Antipodal cells	Degenerate

53. Write the characters of anemophilous plant.

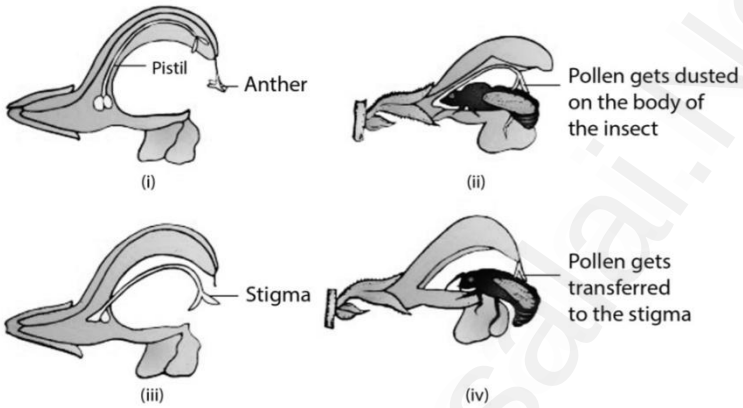
- Flowers in pendulous, catkin like or spike inflorescence.
- The perianth is absent or highly reduced.
- The flowers are small, colourless, not scented, do not secrete nectar.
- The stamens are numerous, filaments are long, exerted and versatile.
- Enormous quantity of pollen grains. compared to number of ovules available for pollination.
- Minute, light, dry pollen easily carried by wind to long distances.

54. Write the functions of endosperm.

- It is the nutritive tissue for the developing embryo.
- The zygote divides only after the development of endosperm.
- Endosperm regulates the precise mode of embryo development.

55. Explain pollination in Salvia (Lever mechanism):

- This flower of salvia is adapted for Bee pollination.
- The flower is protandrous and the corolla is bilabiate with 2 stamens.
- A lever mechanism helps in pollination.
- Each anther has an upper fertile lobe and lower sterile lobe.
- Lower sterile lobe separated by a long connective which helps the anthers to swing freely.
- When a bee visits a flower, it sits on the lower lip which acts as a platform.
- It enters the flower to suck the nectar by pushing its head into the corolla.
- During the entry of the bee into the flower the body strikes against the sterile end of the connective.
- This makes the fertile part of the stamen to descend and strike at the back of the bee.
- The pollen gets deposited on the back of the bee.
- When the bee visits another flower, the pollen is rubbed on stigma. Thus pollination is completed.



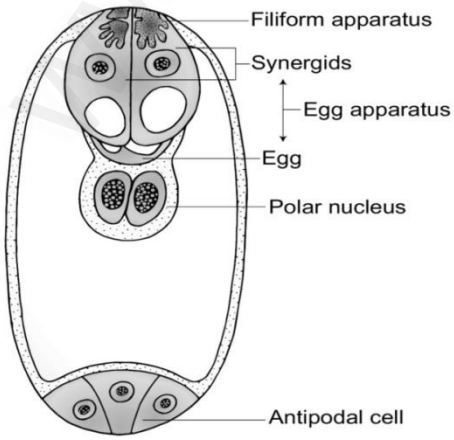
56. Do you think parthenocarpy and apomixis are different process? Justify?

S. No	Parthenocarpy	Apomixis
1.	Fruit may develop from the ovary without fertilization such fruits are called parthenocarpic fruits.	Reproduction does not involve union of male and female gamete is called apomixis.
2.	They do not have true seeds.	Apomixis refers to formation of seeds without fertilization.
3.	Ex : Banana, Grapes.	Ex : Mangifera

57. What is endospermous or ex – albuminous seeds?

- Seeds without endosperms are called non – endospermous seeds.
- Ex : Pea, Groundnut and Beans

58. Draw a structure of embryo sac and label its parts

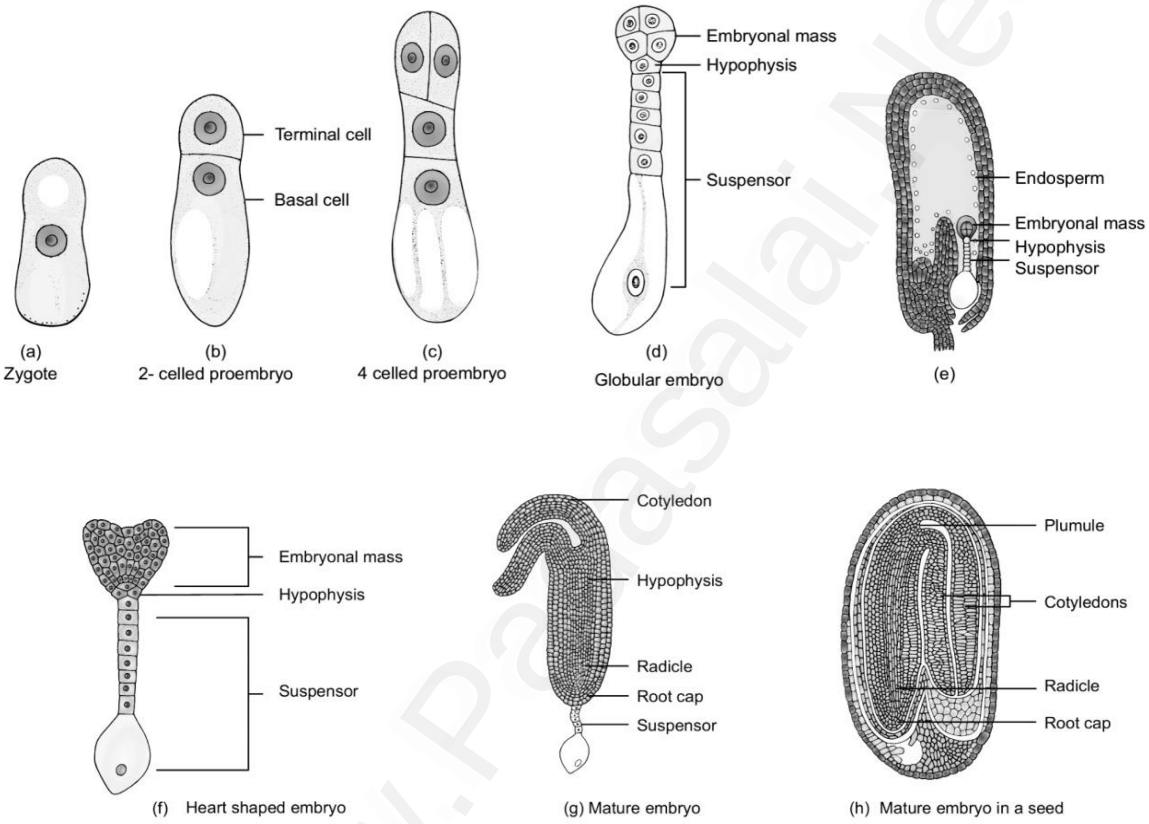


59. Write the parts of mature embryo sac.

- Egg - 1
- Synergids - 2
- Polar nucleus - 2
- Antipodal cells – 3

60. Explain the development of a Dicot embryo.

- The embryo develops at micropylar end of embryo sac.
- The Zygote divides by a transverse division forming upper or terminal cell and lower cell.
- Further divisions in the zygote during the development lead to the formation of embryo.
- Embryo undergoes globular, heart shaped stages before reaching a mature stage.
- The mature embryo has a radicle, two cotyledons and a plumule.



61. Describe about the mature embryo sac.

- The vacuole expands and pushes the nuclei towards the opposite poles of the embryo sac.
- Both the nuclei divide twice mitotically, forming four nuclei at each pole.
- At this stage all the eight nuclei are present in a common cytoplasm.
- Of four nuclei, three nuclei of the micropylar end form an egg apparatus and the fourth one is left free is called upper polar nucleus.
- Three nuclei of the chalazal end form three antipodal cells and fourth one functions as the lower polar nucleus.
- Based on the plant the 2 polar nuclei may remain free
- The egg apparatus is made up of a central egg cell and two synergids.
- Thus, a 7 celled with 8 nucleated embryo sac is formed.

62. Give examples for Helobial endosperm.

- Hydrilla
- Vallisneria.

63. What is Anemophily ?
- Pollination by wind is called Anemophily.

64. What is Hydrophily ?
- Pollination by water is called hydrophily

65. What is Ornithophily ?
- Pollination by Birds is called Ornithophily.

66. What is Chieropterophily ?
- Pollination by Bats is called Chieropterophily.

67. What is Myrmecophily ?
- Pollination by Ants is called Myrmecophily.

68. What is Malacophily ?
- Pollination by Snails is called Malacophily.

69. What is Phalaenophily ?
- Pollination by Moths is called Phalaenophily.

70. What is Psychophily ?
- Pollination by Butterflies is called Psychophily.

71. What is epihydrophily and hypohydrophily ?

Epihydrophily
- Pollination occurs at the water level.
- Ex : Vallisneria spiralis

Hypohydrophily
- Pollination occurs inside the water
- Ex : Zostera marina

72. What is homogamy?
- When the stamens and stigma of a flower mature at the same time are called homogamy.
- Ex : Mirabilis.

73. What is Incomplete dichogamy?
- The stamen and stigma of a flower mature at different time is called dichogamous.

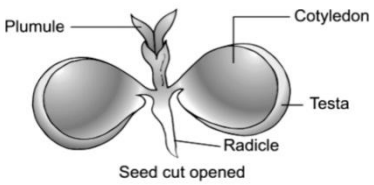
74. Define Cross - pollination.
- The transfer of pollens on the stigma of another flower is called cross-pollination.

75. What is geitonogamy ?
- The pollen deposits on another flower of the same individual plant is called geitonogamy.

76. What is Xenogamy ?
- Genetically different pollen deposits on another flower of a different plant of the same species is called as xenogamy.

77. What is Herkogamy?
- In bisexual flowers, the stamens and stigmas, are arranged different positions. so self-pollination becomes impossible.
- Ex : Gloriosa superba
- The style is reflexed away from the stamens.

78. Draw a structure of Cicer arientinum (Dicot seed) and label its parts.



79. Describe megasporogenesis.

- The process of development of a megaspore from a megaspore mother cell is called megasporogenesis.
- A single hypodermal cell in the nucellus enlarged and functions as archesporium.
- In some plants, the archesporial cell may directly function as megaspore mother cell.
- In others, it divides transversly form outer primary parietal cell and inner primary sporogenous cell.
- The primary sporogenous cell functions as a megaspore mother cell.
- The megaspore mother cell divides meiotically to form four haploid megaspores.
- Based on the number of megaspores that develop into the Embryo sac, we have three basic types of development: monosporic, bisporic and tetrasporic.
- During megasporogenesis of the four megaspores formed, if only one is functional and forms the female gametophyte . This type of development is called monosporic
- Eg : polygonum
- Out of four megaspores, two are involved in Embryo sac formation. This development is called bisporic.
- Ex : Allium.
- If all the four megaspores are involved in Embryo sac formation. This development is called tetrasporic.
- Ex : Peperomia.

80. What is bisporic embryo sac ?

- Out of four megaspores, two are involved in Embryo sac formation.This development is called bisporic.
- Ex : Allium.

81. What is tetrasporic embryo sac ?

- If all the four megaspores are involved in Embryo sac formation.This development is called tetrasporic.
- Ex : Peperomia.

82. Give short notes on sporopollenin ?

- Sporopollenin is present in the exine of pollen grains.
- It contributed by both pollen cytoplasm and tapetum.
- It is resistant to physical and biological decomposition.

Lesson - 2. Classical Genetics

1. Extra nuclear inheritance is a consequence of presence of genes in
   a) Mitrochondria and chloroplasts b) Endoplasmic reticulum and mitrochondria
   c) Ribosomes and chloroplast d) Lysososmes and ribosomes
2. In order to find out the different types of gametes produced by a pea plant having the genotype AaBb, it should be crossed to a plant with the genotype
   a) aaBB b) AaBB c) AABB d) aabb
3. How many different kinds of gametes will be produced by a plant having the genotype AABbCC?
   a) Three b) Four c) Nine d) Two
4. Which one of the following is an example of polygenic inheritance?
   a) Flower colour in Mirabilis Jalapa b) Production of male honey bee
   c) Pod shape in garden pea d) Skin Colour in humans
5. In Mendel's experiments with garden pea, round seed shape (RR) was dominant over wrinkled seeds (rr), yellow cotyledon (YY) was dominant over green cotyledon (yy). What are the expected phenotypes in the F_2 generation of the cross RRYY x rryy?
   a) Only round seeds with green cotyledons
   b) Only wrinkled seeds with yellow cotyledons
   c) Only wrinkled seeds with green cotyledons
   d) Round seeds with yellow cotyledons an wrinkled seeds with yellow cotyledons
6. Test cross involves
   a) Crossing between two genotypes with recessive trait
   b) Crossing between two F_1 hybrids
   c) Crossing the F_1 hybrid with a double recessive genotype
   d) Crossing between two genotypes with dominant trait
7. In pea plants, yellow seeds are dominant to green. If a heterozygous yellow seed pant is crossed with a green seeded plant, what ratio of yellow and green seeded plants would you expect in F_1 generation?
   a) 9:1 b) 1:3 b) 3:1 d) 50:50
8. Select the correct statement from the ones given below with respect to dihydrid cross
   a) Tightly linked genes on the same chromosomes show very few combinations
   b) Tightly linked genes on the same chromosomes show higher combinations
   c) Genes far apart on the same chromosomes show very few recombinations
   d) Genes loosely linked on the same chromosomes show similar recombinations as the tightly linked ones
9. Which Mendelian idea is depicted by a cross in which the F_1 generation resembles both the parents
   a) Incomplete dominance b) Law of dominance
   c) Inheritance of one gene d) Co-dominance
10. Fruit colour in squash is an example of
    a) Recessive epistatsis b) Dominant epistasis
    c) Complementary genes d) Inhibitory genes
11. In his classic experiments on Pea plants, Mendel did not use
    a) Flowering position b) Seed colour
    c) Pod length d) Seed shape

12. The epistatic effect, in which the dihybrid cross 9:3:3:1 between AaBb X AaBb is modified as
a) Dominance of one allele on another allele of both loci
b) Interaction between two alleles of different loci
c) Dominance of one allele to another alleles of same loci
d) Interaction between two alleles of some loci

13. In a test cross involving F_1 dihybrid flies, more parental type offspring were produced than the recombination type offspring. This indicates
a) The two genes are located on two different chromosomes
b) Chromosomes failed to separate during meiosis
c) The two genes are linked and present on the some chromosome
d) Both of the characters are controlled by more than one gene

14. The genes controlling the seven pea characters studied by Mendel are known to be located on how many different chromosomes?
a) Seven b) Six c) Five d) Four

15. Which of the following explains how progeny can posses the combinations of traits that none of the parent possessed?
a) Law of segregation b) Chromosome theory
c) Law of independent assortment d) Polygenic inheritance

16. "Gametes are never hybrid". This is a statement of
a) Law of dominance b) Law of independent assortment
c) Law of segregation d) Law of random fertilization

17. Gene which suppresses other genes activity but does not lie on the same locus is called as
a) Epistatic b) Supplement only c) Hypostatic d) Codominant

18. Pure tall plants are crossed with pure dwarf plants. In the F_1 generation, all plants were tall. These tall plants of F_1 generation were selfed and the ratio of tall to dwarf plants obtained was 3:1. This is called
a) Dominance b) Inheritance
c) Codominance d) Heredity

19. The dominant epistatis ratio is
a) 9:3:3:1 b) 12:3:1 c) 9:3:4 d) 9:6:1

20. Select the period for Mendel's hybridization experiments
a) 1856 - 1863 b) 1850 - 1870
c) 1857 - 1869 d) 1870 - 1877

21. Among the following characters which one was not considered by Mendel in his experimentation pea?
a) Stem – Tall or dwarf b) Trichomal glandular or non-glandular
c) Seed – Green or yellow d) Pod – Inflated or constricted

2, 3, 5 Marks Questions

1. Name the seven contrasting traits of Mendel.

S.NO	Character	Dominant	Recessive
1.	Plant height	Tall	Dwarf
2.	Flower position	Axial	Terminal
3.	Flower colour	Purple	White
4.	Pod form	Inflated	Constricted
5.	Pod colour	Green	Yellow
6.	Seed shape	Round	Wrinkled
7.	Cotyledon colour	Yellow	Green

2. What is meant by true breeding or pure breeding lines / strain?

- Plant has undergone continuous self- pollination having stable trait inheritance from parent to offspring is called true breeding lines.

3. Give the names of the scientists who rediscovered Mendelism.

- Hugo de Vries - Holland
- Carl Correns - Germany
- Erich von Tschermak - Austria.

4. What is back cross?

- It is a cross of F_1 hybrid with any one of the parental genotype is called back cross.
- The back cross is of two types.

Dominent back cross

- When the F_1 offsprings are crossed with the dominant parents.

Recessive back cross

- When the F_1 offsprings are crossed with the recessive parents.

5. Define : Genetics.

- Genetics is the branch of biological science which deals with the mechanism of transmission of characters from parents to off springs.

6. What are multiple alleles ?

- Three or more allelic forms of a gene occupy the same locus in a given pair of homologous chromosomes; these are known as multiple alleles..

7. What are the reasons for Mendel's successes in his breeding experiment?

- He applied mathematics and statistical methods to biology.
- He followed scientific methods and kept accurate and detailed data records of the outcome of his crosses.
- His experiments were carefully planned and he used large samples.
- The parents selected by Mendel were pure breed lines.
- The purity was tested by self crossing the progeny for many generations.

8. Explain the law of dominance in monohybrid cross.

- The characters are controlled by discrete units called factors which occur in pairs.
- In a dissimilar pair of factors one member of the pair is dominant and the other is recessive.
- This law gives an explanation to the monohybrid cross.
- The expression of only one of the parental characters in F_1 generation.
- The expression of both in the F_2 generation.
- It also explains the proportion of 3:1 obtained at the F_2.

Parent **Tall** **Dwarf**
TT **tt**

Gametes **T** **t**

F1 = **Tt (Tall)**

F_1 (Selfed) **Tt** x **Tt**

F2 =

Gametes	T	t
T	**TT** Tall	**Tt** Tall
t	**Tt** Tall	**tt** Dwarf

Genotypes : **TT Tt tt**
Genotypic Ratio : **1 : 2 : 1**

Phenotypes : **Tall Dwarf**
Phenotypic Ratio : **3 : 1**

9. Differentiate incomplete dominance and co dominance.

S.NO	Incomplete dominance	Co dominance
1.	Effect of one of the two alleles is more conspicuous.	Effects of both the alleles are equally conspicuous.
2.	The effect in hybrid is intermediate expression of the two alleles.	Both the alleles are produces their effect independently
3.	It produces new phenotype.	Does not produce new phenotype.
4.	Qualitative approach of the gene expression.	Quantitative approach of the gene expression.
5.	Ex. Mirabilis jalapa.	Ex : Red and white flowers of Camellia.

10. What is meant by cytoplasmic inheritance?

- DNA is the universal genetic material. Certain traits are governed either by the chloroplast or mitochondrial genes.
- Cytoplasmic organelles such as chloroplast and mitochondrion that act as inheritance vectors, it is also called Cytoplasmic inheritance.

11. Explain with an example how single gene affect multiple traits and alleles the phenotype of an organism.

- A single gene affects multiple traits and alter the phenotype of the organism is called Pleiotropy.
- The Pleiotropic gene influences a number of characters simultaneously. Such genes are called pleiotropic gene.
- Mendel noticed pleiotropy while performing breeding experiment with peas (Pisum sativum).
- purple flowers, brown seeds and dark spot on the axils of the leaves crossed with white flowers, light coloured seeds and no spot on the axils of the leaves,
- The three traits for flower colour, seed colour and a leaf axil spot all were inherited together as a single unit.
- This is due to the three traits were controlled by a single gene with dominant and recessive alleles.

12. Describe dominant epistasis with an example.

- The gene that suppresses or masks the phenotypic expression of a gene at another locus is known as epistatic.
- The inhibiting gene is called epistatic gene .The inhibited gene is called hypostatic gene.

Parent **White fruit** **Yellow fruit**
WWgg **wwGG**

Gametes **Wg** **wG**

F_1 (Selfed) **WwGg**

WwGg X wwGg

F_2 =

	WG	**Wg**	**wG**	**wg**
WG	**WWGG** White	**WWGg** White	**WwGG** White	**WwGg** White
Wg	**WWGg** White	**WWgg** White	**WwGg** White	**Wwgg** White
wG	**WwGG** White	**WwGg** White	**wwGG** Yellow	**wwGg** Yellow
Wg	**WwGg** White	**Wwgg** White	**wwGg** Yellow	**wwgg** Green

Phenotypes : White fruit : Yellow fruit : Green fruit
12 : 3 : 1

- Ratio : 12 : 3 : 1
- In the summer squash the fruit colour locus has a dominant allele 'W' for white colour and a recessive allele 'w' for coloured fruit.
- 'W' allele is dominant that masks the expression of any colour.
- The white fruit (WWgg) is crossed with yellow fruit (wwGG).
- The F_1 plants have white fruit and are heterozygous (WwGg).
- The F_1 heterozygous plants are crossed.
- They give rise to F_2 with the phenotypic ratio of 12 white : 3 yellow : 1 green.
- Dominent white (W) hides the effects of yellow or green.
- Homozygous recessive ww genotypes only give the coloured fruits (4/16).
- Double recessive 'wwgg' will give green fruit (1/16).
- The Plants having only 'G' in its genotype (wwGg or wwGG) will give the yellow fruit (3/16).

13. Differentiate continuous variation with discontinuous variation.

S.NO	Continuous Variation	Discontinuous Variation
1	This variation due to the combining effects of environmental and genetic factors	This variations are genetically determined by inheritance factors.
2	The phenotype is determined by many genes, and environmental factors.	The phenotypic expression is unaffected by environmental conditions.
3	Directions of continuous variations is predictable.	Directions of discontinuous variations is unpredictable.
4	This is also called as quantitative inheritance	This is also called as qualitative inheritance.
5	Ex : Human height and skin colour	Ex : Style length in primula plant height of garden pea.

14. Explain polygenic inheritance with an example.

- A group of genes that together determine a characteristic of an organism is called polygenic inheritance.
- It was first demonstrated by Swedish Geneticist H. Nilsson - Ehle in wheat kernels.
- Kernel colour is controlled by two genes each with two alleles, one with red kernel colour was dominant to white.
- He crossed the two pure breeding wheat varieties dark red and a white.
- Dark red genotypes $R_1R_1R_2R_2$ and white genotypes are $r_1r_1r_2r_2$.
- In the F_1 generation medium red were obtained with the genotype $R_1r_1R_2r_2$.
- F1 selfing produces four types of gametes R_1R_2, R_1r_2, r_1R_2, r_1r_2.
- The intensity of the red colour is determined by the number of R genes in the F2 generation.
- Four R genes - A dark red kernel colour.
- Three R genes - Medium dark red.
- Two R genes - Medium red.
- One R gene - Light red.
- Absence of R gene - White kernel colour.

Parent **Dark Red** $R_1R_1R_2R_2$ **white** $r_1r_1r_2r_2$

Gametes R_1R_2 ⇩ r_1r_2

F_1 = $R_1r_1R_2r_2$ **(Medium red)**

F_1 (selfed) = $R_1r_1R_2r_2$ x $R_1r_1R_2r_2$

⇩

F_2 =

G	R_1R_2	R_1r_2	r_1R_2	r_1r_2
R_1R_2	$R_1R_1R_2R_2$ Dark red	$R_1R_1R_2r_2$ Medium dark red	$R_1r_1R_2R_2$ Medium dark red	$R_1r_1R_2r_2$ Medium red
R_1r_2	$R_1R_1R_2r_2$ Medium dark red	$R_1R_1r_2r_2$ Medium red	$R_1r_1R_2r_2$ Medium red	$R_1r_1r_2r_2$ Light red
r_1R_2	$R_1r_1R_2R_2$ Medium dark red	$R_1r_1R_2r_2$ Medium red	$r_1r_1R_2R_2$ Medium red	$r_1r_1R_2r_2$ Light red
r_1r_2	$R_1r_1R_2r_2$ Medium red	$R_1r_1r_2r_2$ Light red	$r_1r_1R_2r_2$ Light red	$r_1r_1r_2r_2$ White

Conclusion

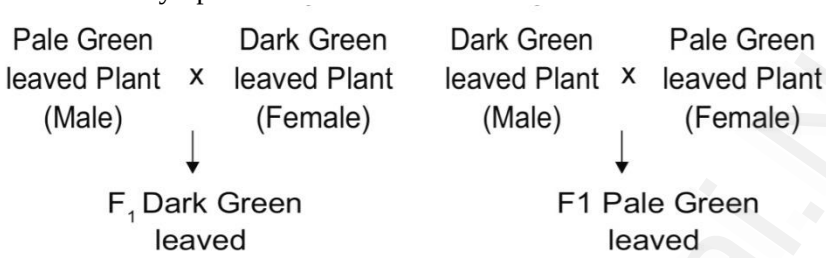
- Finally the loci that was studied by Nilsson – Ehle were not linked and the genes assorted independently.
- Later, researchers discovered the third gene that also affects the kernel colour of wheat.
- The three independent pairs of alleles were involved in wheat kernel colour.
- Nilsson – Ehle found the ratio of 63 red : 1 white in F_2 generation.
- 1 : 6 : 15 : 20 : 15 : 6 : 1 in F_2 generation.

15. Bring out the inheritance of chloroplast gene with an example.

- DNA is the universal genetic material. Certain traits are governed either by the chloroplast or mitochondrial genes.
- Cytoplasmic organelles such as chloroplast and mitochondrion that act as inheritance vectors, it is also called Cytoplasmic inheritance.
- It is found in 4 O' Clock plant (Mirabilis jalapa).
- There are two types of variegated leaves

- Dark green leaved plants
- Pale green leaved plants.

- When the pollen of dark green leaved plant (male) is transferred to the stigma of pale green leaved plant (female) and pollen of pale green leaved plant is transferred to the stigma of dark green leaved plant.
- The F1 generation of both the crosses must be identical as per mendelian inheritance.
- But in the reciprocal cross the F_1 plant differs from each other.
- In each cross, the F_1 plant reveals the character of the plant which is used as female plant.
- This inheritance is not through nuclear gene.
- It is due to the chloroplast gene found in the ovum of the female plant
- It contributes the cytoplasm during fertilization. Since the male gamete contribute only the nucleus but not cytoplasm.



Additional Questions

16. What is lethal allele ?

- An allele which has the potential to cause the death of an organism is called lethal allele.
- Ex : Snapdragon.

17. What are alleles ?

- Alternate forms for the same trait is called alleles.

18. What is Co dominance?

- The phenomenon in which two alleles are both expressed in the heterozygous individual is known as co dominance.

19. What is test cross?

- Crossing an individual of unknown genotype with a homozygous recessive is called Test cross.

20. What is a Atavism ?

- Atavism is a modification of a biological structure.
- An ancestral that reappears after having been lost through evolutionary changes in the previous generation.

21. What is incomplete dominance ?

- When one allele is not completely dominant to another allele it shows incomplete dominance.

22. Name the three types of phenotype observed in plants in snapdragon.

- Green plants with chlorophyll (cc)
- Yellowish green plants (Cc)
- White plants without any chlorophyll (cc)

23. What is reciprocal cross

- The tall pea plants were pollinated with the pollens from a dwarf plants, the result was all tall plants.
- When the parental types were reversed, the pollen from a tall plant was used to pollinate a dwarf pea plant which gave only tall plants. The result was the same.
- So it was concluded that the trait is not sex dependent.

24. Explain about dihybrid cross.

- The crossing of two plants differing in two pairs of contrasting traits is called dihybrid cross.

Parent **Round Yellow** **RRYY** **Wrinkled Green** **rryy**

Gametes **RY** **ry**

⇩

F_1 (selfed) **RrYy**

RrYy x **RrYy**

Gametes : Ry Ry rY ry **RY Ry rY ry**

⇩

F_2 =

	RY	**Ry**	**rY**	**ry**
RY	**RRYY** R.Y	**RRYy** R.Y	**RrYY** R.Y	**RrYy** R.Y
Ry	**RRYy** R.Y	**RRyy** R.G	**RrYy** R.Y	**Rryy** R.G
rY	**RrYY** R.Y	**RrYy** R.Y	**rrYY** W.Y	**rrYy** W.Y
ry	**RrYy** R.Y	**Rryy** R.G	**rrYy** W.Y	**rryy** G.W

- **Phenotypic ratio : 9 : 3 : 3 : 1**

- Yeelow Round (YR) – 9 / 16
- Yellow Wrinkled (Yr) – 3 / 16
- Green Round (yR) – 3 / 16
- Green Wrinkled (yr) – 1 / 16

25. Why did mental choose pea plants for his experiments ?

- It is an annual plant.
- It has clear contrasting characters that are controlled by a single gene separately.
- Mendel used both self-fertilization and cross-fertilization.
- The flowers are large hence emasculation and pollination are very easy for hybridization.

26. Name the four major subdisciplines of genetics.

Transmission Genetics

- Deals with the transmission of genes from parents to off springs.
- Th e foundation of classical genetics came from the study of hereditary behaviour of seven genes by Gregor Mendel.

Molecular Genetics

- Deals with the structure and function of a gene at molecular level.

Population Genetics

- Deals with heredity in groups of individuals for traits which is determined by a few genes.

Quantitative Genetics

- Deals with heredity of traits in groups of individuals where the traits are governed by many genes simultaneously.

27. State the laws of inheritance proposed by Mendel

Law of independent Assortment

- When two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent to the other pair of characters.

Law of segregation

- Though the parents contain two alleles during the gamete formation, the factors or alleles of a pair segregate from each other, such that the gamete receives only one of the two factors.

28. Why is mendel called as father of genetics ?

- Mendelian genetic concepts are basic to modern genetics. Therefore, Mendel is called as Father of Genetics.

29. Gametes are never hybrid – Justify.

- A homozygous parent produces similar gametes and a heterozygous parent produces two kinds gametes each having one allele with equal proportion.
- During the formation of gametes, the alleles of a pair separate and segregate from each other.
- Each gamete receives only one of the two factors.

30. What is incomplete dominance ? In 4 O' clock plant shows incomplete dominance for flower colour.

- When one allele is not completely dominant to another allele it shows incomplete dominance.
- Carl correns's experimented in 4 o' clock plant Mirabilis jalapa.
- The homozygous red (R^1R^1) parent is crossed with white (R^2R^2).
- The F_1 phenotype differs from both the parental phenotype.
- The F_1 generation produces an intermediate colour pink (R^1R^2).
- Here one allele is not completely dominant to another allele. Such allelic interaction is known as incomplete dominance.
- The pink coloured plants of F_1 generation were interbred.
- In F_2 both phenotypic and genotypic ratios were found to be identical as 1 : 2 : 1.
- R^1 allele codes for an enzyme responsible for the formation of red pigment.
- R^2 allele codes for an enzyme responsible for the formation of white pigment.
- R^1 and R2 genotypes produce only enough red pigments to make the flower pink.
- In F_2 both phenotypic and genotypic ratios are 1 : 2 : 1.

Parent **Red** R^1R^1 **White** R^2R^2

Gametes R^1 R^2

F_1 = R^1R^2 **(pink colour)**

F_1 (Selfed) = R^1R^2 x R^1R^2

F_2 =

Gametes	R^1	R^2
R^1	R^1R^1 Red	R^1R^2 Pink
R^2	R^1R^2 Pink	R^2R^2 White

Phenotypes : R^1R^1 R^1R^2 R^2R^2

Phenotypic Ratio : 1 : 2 : 1

31. Mitochondrial Inheritance - Explain.

- DNA is the universal genetic material. Certain traits are governed either by the chloroplast or mitochondrial genes.
- Cytoplasmic organelles such as chloroplast and mitochondrion that act as inheritance vectors, it is also called Cytoplasmic inheritance.
- Male sterility found in pearl maize (Sorgum vulgare) is the best example for mitochondrial cytoplasmic inheritance.
- Male sterility found in this pearl maize so it is called cytoplasmic male sterility.
- The gene for cytoplasmic male sterility is found in the mitochondrial DNA.
- There are two types
  - One with normal cytoplasm (N) - Male fertile.
  - The other one with aberrant cytoplasm (S) - Male sterile.
- These types also exhibit reciprocal differences as found in Mirabilis jalapa.
- Recently it has been discovered that cytoplasmic genetic male sterility is common in many plant species.
- This sterility is maintained by the influence of both nuclear and cytoplasmic genes.
- There are commonly two types of cytoplasm
  - N (normal)
  - S (sterile)
- The genes for these are found in mitochondrion.there are also restores of fertility (Rf) genes.
- Even though these genes are nuclear genes, they are distinct from genetic male sterility genes of other plants. Because the Rf genes do not have any expression of their own, unless the sterile cytoplasm is present.
- Rf genes are required to restore fertility in S cytoplasm which is responsible for sterility.
- So the combination of N cytoplasm with rfrf and S cytoplasm with RfRf produces plants with fertile pollens, while S cytoplasm with rfrf produces only male sterile plants.

"Don't take rest after your first victory because if you fail in second, more lips are waiting to say that your first victory was just luck"

- DR APJ ABDUL KALAM

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Lesson - 3. Chromosomal Basis of Inheritance

1. An allohexaploidy contains
   a) Six different genomes
   b) Six copies of three different genomes
   c) Two copies of three different genomes
   d) Six copies of one genome

2. Match list I with list II

	List I		List II
A.	A pair of chromosomes extra with diploid	i)	Monosomy
B.	One chromosome extra to the diploid	ii)	Tetrasomy
C.	One chromosome loses from diploid	iii)	Trisomy
D.	Two individual chromosomes lose from diploid	iv)	double monosomy

   a) A-i, B-iii, C-ii, D-iv
   b) A-ii, B-iii, C-iv, D-I
   c) A-ii, B-iii, C-i, D-iv
   d) A-iii, B-ii, C-i, D-iv

3. Which of the following sentences are correct?
   1. The offspring exhibit only parental combinations due to incomplete linkage
   2. The linked genes exhibit some crossing over in complete linkage
   3. The separation of two linked genes are possible in incomplete linkage
   4. Crossing over is absent in complete linkage
   a) 1 and 2 b) 2 and 3 c) 3 and 4 d) 1 and 4

4. Due to incomplete linkage in maize, the ratio of parental and recombinants are
   a) 50:50 b) 7:1:1:7 c) 96.4: 3.6 d) 1:7:7:1

5. The point mutation sequence for transition, transition, transversion and transversion in DNA are
   a) A to T, T to A, C to G and G to C
   b) A to G, C to T, C to G and T to A
   c) C to G, A to G, T to A and G to A
   d) G to C, A to T, T to A and C to G

6. If haploid number in a cell is 18. The double monosomic and trisomic number will be
   a) 34 and 37 b) 34 and 35 c) 37 and 35 d) 17 and 19

7. Changing the codon AGC to AGA represents
   a) missense mutation
   b) nonsense mutation
   c) frameshift mutation
   d) deletion mutation

8. **Assertion (A):** Gamma rays are generally use to induce mutation in wheat varieties.
   Reason (R) : Because they carry lower energy to non-ionize electrons from atom
   a) A and R are correct
   b) A is correct. R is wrong
   c) A is wrong. R is correct
   d) A and R are wrong

2, 3, 5 Marks Questions

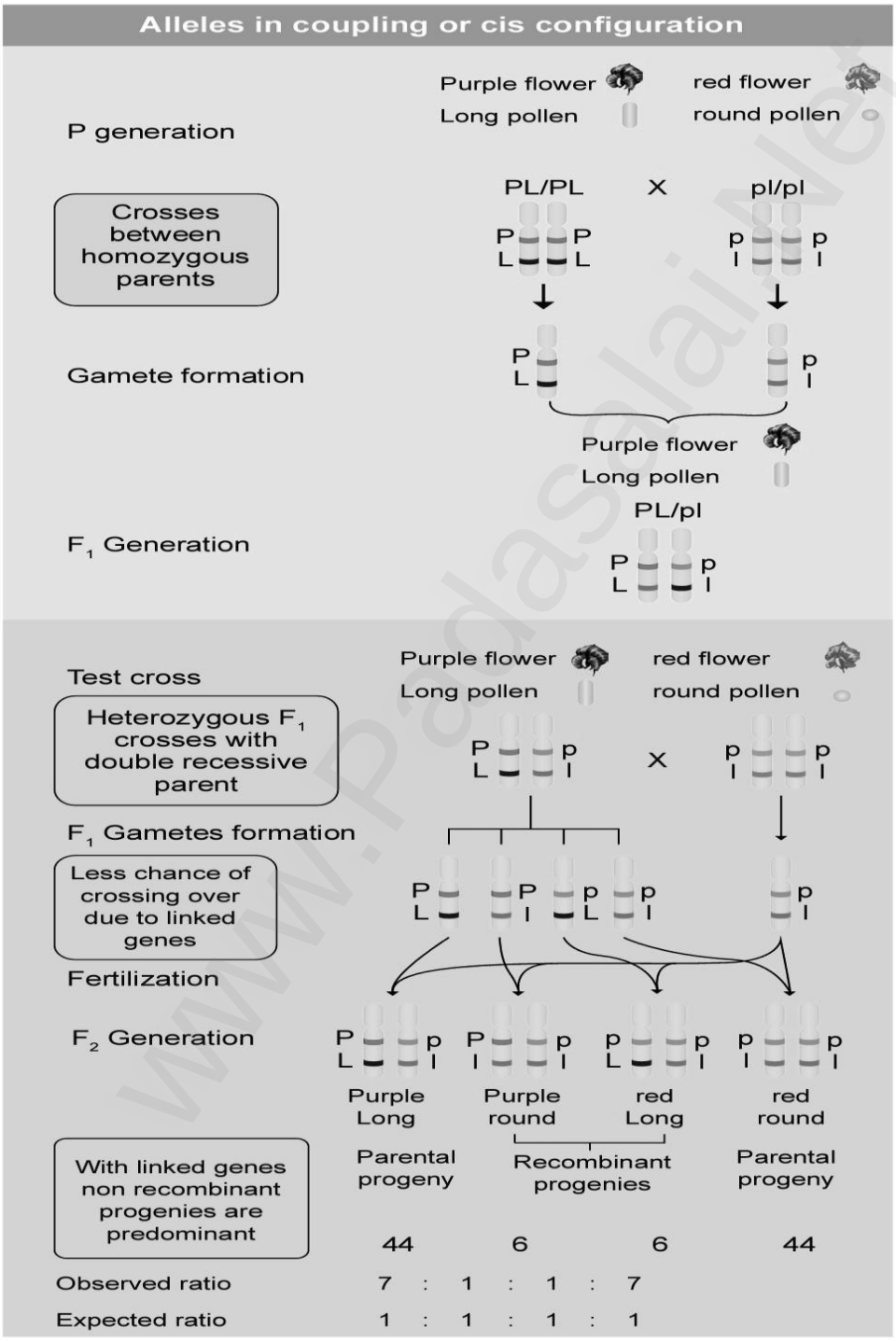
1. When two different genes came from same parent they tend to remain together.

i) What is the name of this phenomenon?

ii) Draw the cross with suitable example.

iii) Write the observed phenotypic ratio.

- The name of this phenomenon **: coupling.**
- The observed phenotypic ratio **: 7:1:1:7**



2. What is the difference between missense and nonsense mutation?

S.NO	Missense mutation	Nonsense mutation
1.	The mutation where the codon for one amino acid is changed into a codon for another amino acid is called Missense mutations.	The mutations where codon for one amino acid is changed into a termination or stop codon is called Nonsense mutation.

3. Explain the mechanism of crossing over.

- The stages of the mechanism of crossing over are
  i) Synapsis, ii) Tetrad formation
  iii) Cross over iv) Terminalization.

i) Synapsis

- It is initiated during zygotene stage of prophase I of meiosis I.
- Homologous chromosomes pairs are aligned side by side called bivalents.
- The pairing between two homologous chromosomes are called synapsis or syndesis.

ii) Tetrad Formation

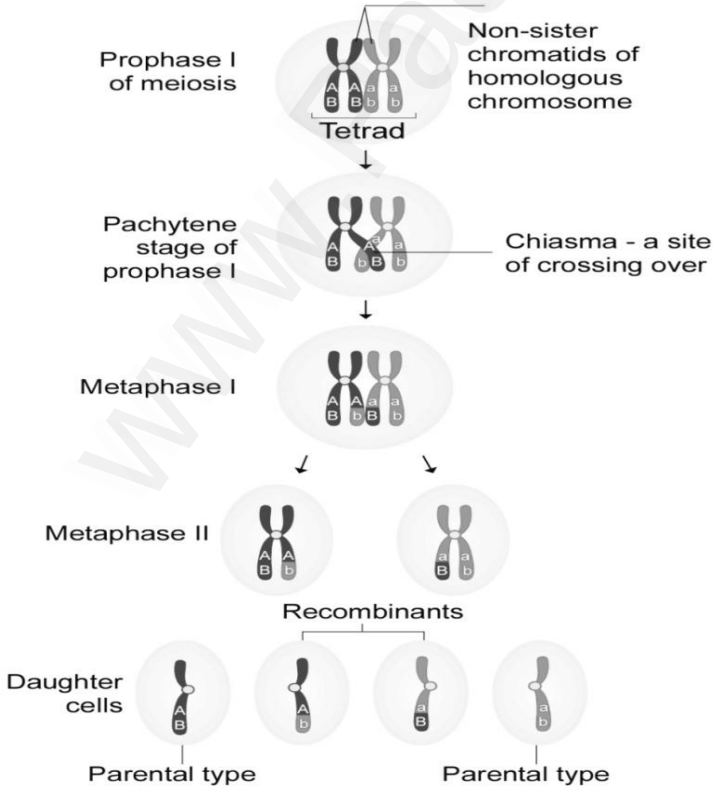
- Each homologous chromosome form two identical sister chromatids. Which remain held together by a centromere.
- At this stage each bivalent has four chromatids. This stage is called tetrad stage.

iii) Cross Over

- Crossing over occurs in pachytene stage.
- The non-sister chromatids of homologous pair make a contact at one or more points are called Chiasmata.
- At chiasma, cross-shaped or X-shaped structures are formed.
- Where breaking and re-joining of two chromatids occur in that point.
- This results in reciprocal exchange of equal and corresponding segments between them.

v) Terminalisation

- After crossing over, chiasma starts to move towards the terminal end of chromatids. This is known as terminalisation.
- As a result, complete separation of homologous chromosomes occurs.



4. From the above figure identify the type of mutation and explain it.

- **Type :** Reverse tandem duplication
- The duplicated segment is located immediately after the normal segment but the gene sequence order will be reversed.

5. Write the salient features of Sutton and Boveri concept.

- Somatic cells of organisms are derived from the zygote by mitosis. These consist of two identical sets of chromosomes.
- One set is received from female parent and the other from male parent. These two chromosomes constitute the homologous pair.
- Chromosomes retain their structural uniqueness and individuality throughout the life cycle of an organism.
- Each chromosome carries mendelian factors which are now termed as genes.
- The behaviour of chromosomes during the gamete formation provides evidence to the fact that genes or factors are located on chromosomes.

6. How is Nicotiana exhibit self - incompatibility. Explain its mechanism.

- In plants, multiple alleles have been reported in association with self-sterility or self incompatibility.
- Self-sterility means that the pollen from a plant is unable to germinate on its own stigma. This will not be able to bring about fertilization in the ovules of the same plant.
- East (1925) observed multiple alleles in Nicotiana which are responsible for self-sterility.
- The gene for self-incompatibility can be designated as S, which has allelic series S_1, S_2, S_3, S_4 and S_5.
- The cross-fertilizing tobacco plants were not always homozygous as S_1S_1 or S_2S_2, but all plants were heterozygous as S_1S_2, S_3S_4, S_5S_6.
- When crosses were made between different S_1S_2 plants, the pollen tube did not develop normally.
- But effective pollen tube development was observed when crossing was made with other than S_1S_2 for example S_3S_4.
- When crosses were made between seed parents with S_1S_2 and pollen parents with S_2S_3, two kinds of pollen tubes were distinguished.
- Pollen grains carrying S_2 were not effective, but the pollen grains carrying S_3 were capable of fertilization.

Female parent (Stigma spot)	**Male parent (Pollen source)**		
	S_1S_2	**S_2S_3**	**S_3S_4**
S_1S_2	Self sterile	S_3S_2 S_3S_1	S_3S_1 S_3S_2 S_4S_1 S_4S_2
S_2S_3	S_1S_2 S_1S_3	Self sterile	S_4S_2 S_4S_3
S_3S_4	S_1S_3 S_1S_4 S_2S_3 S_2S_4	S_2S_3 S_2S_4	Self sterile

7. How sex is determined in monoecious plants. write their genes involved in it.

- Zea mays (maize) is an example for monoecious. which means male and female flowers are present on the same plant
- There are two types of inflorescence.
- Terminal staminate florets develops from shoot apical meristem called tassel.
- The lateral inflorescence which develops pistillate florets from axillary bud is called ear or cob.
- Unisexuality in maize occurs through the selective abortion of stamens in ear florets and pistils in tassel florets.
- A substitution of two single gene pairs 'ba' for barren plant and 'ts' for tassel seed makes the difference between monoecious and dioecious (rare) maize plants.
- The allele for barren plant (ba) when homozygous makes the stalk staminate by eliminating silk and ears.
- The allele for tassel seed (ts) transforms tassel into a pistillate structure that produce no pollen.
- Most of these mutations are shown to be defects in gibberellin biosynthesis.

Genotype	Dominant/ recessive	Modification	Sex
ba/ba ts/ts	Double recessive	Lacks silk on the stalk, but transformed tassel to pistil	Rudimentary female
ba/ba ts^+/ts^+	Recessive and dominant	Lacks silk and have tassel	Male
ba^+/ba^+ ts^+/ts^+	Double dominant	Have both tassel and cob	Monoecious
ba^+/ba^+ ts/ts	Dominant and recessive	Bears cob and lacks tassel	Normal female

8. What is gene mapping? Write its uses.

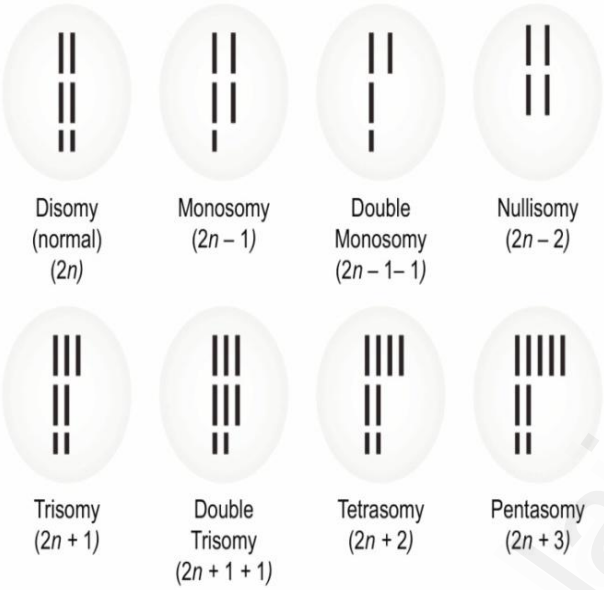
- The diagrammatic representation of position of genes and related distances between the adjacent genes is called genetic mapping.
- It is also called as linkage map.
- It provides clues about where the genes lies on that chromosome.

Uses

- It is used to determine gene order, identify the locus of a gene and calculate the distances between genes.
- It is useful in predicting results of dihybrid and trihybrid crosses.
- It allows the geneticists to understand the overall genetic complexity of particular organism.

9. Draw the diagram of different types of aneuploidy.

- Diploid number is altered either by addition or deletion of one or more chromosomes are called Aneuploidy.
- They are of two types 1. Hyperploidy 2. Hypoploidy



10. Mention the name of man-made cereal. How it is formed?

- Triticale is the successful first man made cereal.
- Depending on the ploidy level Triticale can be divided into three main groups.

Tetraploidy

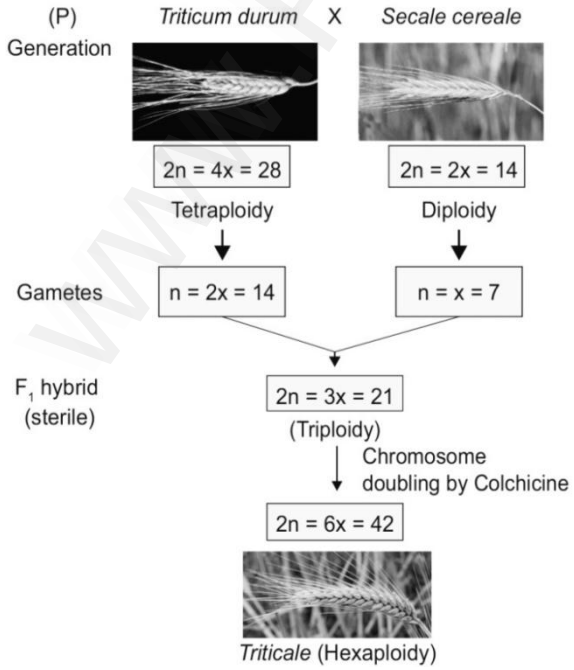
- Crosses between diploid wheat and rye.

Hexaploidy

- Crosses between tetraploid wheat Triticum durum (macaroni wheat) and rye

Octoploidy

- Crosses between hexaploid wheat T. aestivum (bread wheat) and rye
- Ex : They combine the high-protein content of wheat with rye's high content of the amino acid lysine, which is low in wheat. It can be explained by chart below



Additional Questions

11. Define : Crossing over.

- Inter-changing the corresponding segments between non-sister chromatids of homologous pair of chromosomes is called Crossing over.

12. Write the importance of Crossing over?

- Crossing over leads to new gene combinations which plays an important role in evolution.
- Studies of crossing over reveal that genes are arranged linearly on the chromosomes.
- Genetic maps are made based on the frequency of crossing over.
- Crossing over helps to understand the nature and mechanism of gene action.
- A useful new combination is formed it can be used in plant breeding.

13. Write short note on Colchicine.

- Colchicine an alkaloid is extracted from root and corms of Colchicum autumnale.
- When applied in low concentration to the growing tips of the plants it will induce polyploidy.

14. Define: Mutation

- A sudden change in the genetic material of an organisms is called mutation.

15. Mention few physical mutagens.

- Temperature
- X rays,
- Alfa rays
- Beta rays
- Gamma rays
- Cosmic rays
- UV rays.

16. Write short notes on Sonora - 64.

- Sharbati Sonora is a mutant variety of wheat.
- It is developed from Mexican variety by irradiating of gamma rays.
- It is the work of Dr. M.S. Swaminathan and his team.

17. Describe Castor Aruna.

- Castor Aruna is mutant variety of castor.
- Which is developed by treatment of seeds with thermal neutrons.
- It induce very early maturity.
- 120 days instead of 270 days as original variety.

18. What are chemical mutagenes ? Give example.

- Chemicals which induce mutation are called chemical mutagens.

Ex :

- Mustard gas
- Nitrous acid
- EMS
- MMS
- Magnous salt
- Formaldehyde
- Eosin.

19. What are comutagens ? Give examples.

- The compounds which are not having own mutagenic properties. But can enhance the effects of known mutagens are called comutagens.
- Ex : Ascorbic acid.

20. Give brief account on significance of ploidy.

- Many polyploids are more vigorous and more adaptable than diploids.
- Many ornamental plants are auto tetraploids and have larger flower and longer flowering duration than diploids.
- Autopolyploids usually have increase in fresh weight due to more water content.
- Aneuploids are useful to determine the phenotypic effects of loss or gain of different chromosomes.
- Many angiosperms are allopolyploids and they play a role in an evolution of plants.

21. How does linkage differ from crossing over ?

	Linkage	Crossing over
1	The genes present on chromosome Stay close together.	It leads to separation of linked genes
2	It involves same chromosome of homologous chromosome.	It involves exchange of segments between non-sister chromatids of homologous chromosome.
3	It reduces new gene combinations	It increases variability by forming new gene Combinations. lead to formation of new Organism

22. What are called linked genes?

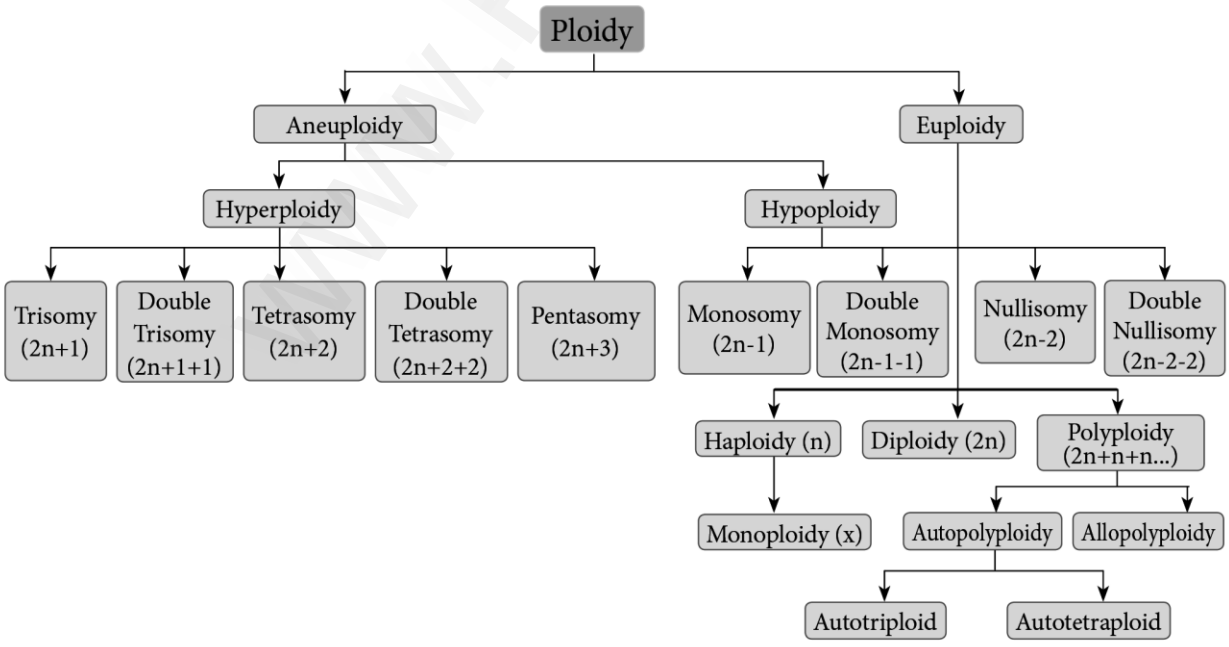
- Genes located close together on the same chromosome and inherited together are called linked genes.

23. What is meant by unlinked genes or syntenic genes?

- The two genes that are sufficiently far apart on the same chromosome are called unlinked genes or syntenic genes.
- Such condition is known as synteny.

24. Draw the flow chart of ploidy

- Diploid number is altered either by addition or deletion of one or more chromosomes are called Aneuploidy.
- They are of two types
  - Hyperploidy
  - Hypoploidy.



Hyperploidy

- Addition of one or more chromosomes to diploid sets are called hyperploidy.

Trisomy

- Addition of single chromosome to diploid set is called Simple trisomy (2n+1)
- Ex : Datura stramonium, Nicotiana, Pisum
- Sometimes addition of two individual chromosome from different chromosomal pairs to normal diploid sets are called Double trisomy (2n+1+1)

Tetrasomy

- Addition of a pair of chromosomes to diploid set is called tetrasomy (2n+2).
- Addition of two individual pairs of chromosomes to diploid set is called Double tetrasomy (2n+2+2)
- Ex : Wheat.

Pentasomy

- Addition of three individual chromosome from different chromosomal pairs to normal diploid set are called pentasomy (2n+3)

Hypoploidy

- Loss of one or more chromosome from the diploid set in the cell is called hypoploidy.It is two types.

Monosomy

- Loss of a single chromosome from the diploid set are called monosomy (2n-1)
- Loss of two individual chromosomes are called double monosomy (2n-1-1)
- Loss of three individual chromosomes are called and triple monosomy (2n-1-1-1)

Nullisomy

- Loss of a pair of homologous chromosomes from the diploid set are called Nullisomy (2n- 2)
- Loss of two pairs of homologous chromosomes from the diploid set are called double Nullisomy (2n-2-2).

Euploidy

- The organisms possess one or more basic sets of chromosomes are called Euploidy.
- It is classified as monoploidy, diploidy and polyploidy.
- An organism or somatic cell has two sets of chromosomes are called diploid (2n)
- Half the number of somatic chromosomes is referred as gametic chromosome number called haploid(n).

25. What are the types of mutation?

- Point mutation
- Chromosomal mutations.

Point mutation

- Mutations affecting single base or base pair of DNA are called point mutation.

Chromosomal mutations

- Mutations altering the number of copies of a small repeated nucleotide sequence within a gene.

26. Write the number of chromosomes for the following organisms.

S.NO	Organism	Number of chromosome (2n)
A	Adder's tongue fern	1262
B	Rice	24
C	Sugarcane	80
D	Apple	34
E	Potato	48

27. What is meant by structural changes in chromosome Classify them.

- They are classified under two groups.

Changes in the number of the gene loci

- Deletion or Deficiency
- Duplication or Repeat

Changes in the arrangement of gene loci

- Inversion
- Translocation

Deletion

- Loss of a portion of chromosome is called deletion.
- It is divided into terminal deletion and intercalary deletion.

Terminal deletion

- Single break in any one end of the chromosome.

Example :

- Drosophila, Maize.

Intercalary deletion

- It is caused by two breaks and reunion of terminal parts leaving the middle.
- It occurs due to chemicals, drugs and radiations.

Duplication or Repeat

- Arrangement of the same order of genes repeated more than once in the same chromosome is known as duplication.
- It was first reported in Drosophila by Bridges.

Example :

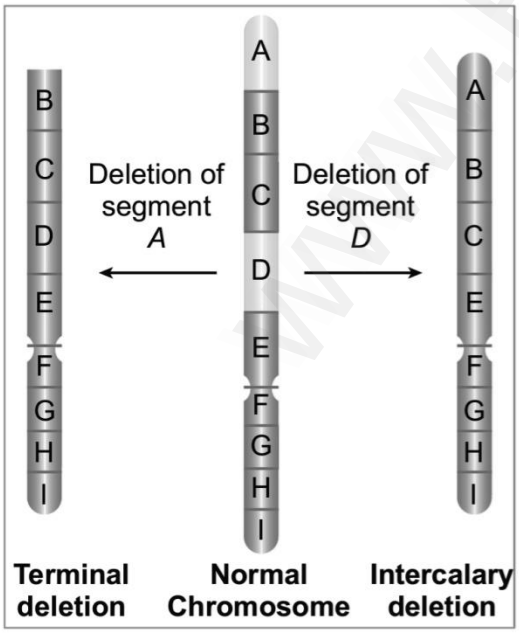
- Maize, Pea.

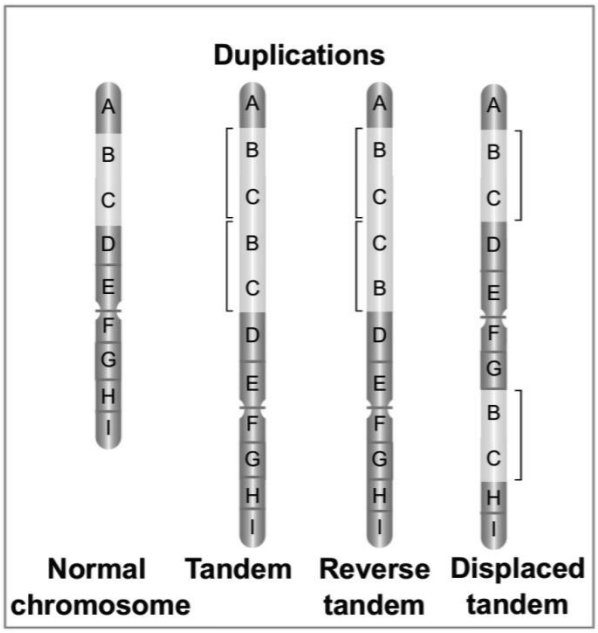
Inversion

- A rearrangement of order of genes in a chromosome by reversed by an angle 180^0.
- During this process there is neither gain nor loss. but the gene sequences is rearranged.

Translocation

- The transfer of a segment of chromosome to a non-homologous chromosome is called translocation.
- There are three types
  - Simple translocation
  - Shift translocation
  - Reciprocal translocation





28. Name the three types of synapsis.

- Procentric synapsis
- Proterminal synapsis
- Random synapsis

29. Explain the types of mutation with illustration.

- Based on the molecular change, mutations are four types

Transition mutation:

- A base pair in DNA duplex is replaced with a different base pair (i.e) purine to purine (AG) or pyrimidine to pyrimidine (TC)

Transversion mutation:

- Replaced with purine to pyrimidine (AT) or pyrimidine to purine(CG)

Insertion mutation :

- One or more extra nucleotides are present

Deletion mutation :

- One or more nucleotides are missing
- Based on the effect on translation, mutations are four types

Silent (synonymous) mutation:

- No change in amino acid encoded

Missense (non-synonymous) mutation:

- Change in amino acid encoded

Nonsense (termination) mutation:

- Creates translational termination codon (UAA, UAG, or UGA)

Frame shift mutation:

- Shifts triplet reading of codons out of correct phase

30. What is the difference between Paracentric inversion and Pericentric inversion ?

Paracentric inversion:

- An inversion which takes place apart from the centromere.

Pericentric inversion:

- An inversion that includes the centromere.

Lesson – 4 Principles and Processes of Biotechnology

1. Restriction enzymes are
   a) Not always required in genetic engineering
   b) Essential tools in genetic engineering
   c) Nucleases that cleave DNA at specific sites
   d) both b and c
2. Plasmids are
   a) circular protein molecules b) required by bacteria
   c) tiny bacteria d) confer resistance to antibiotics
3. EcoRI cleaves DNA at
   a) AGGGTT b) GTATATC
   c) GAATTC d) TATAGC
4. Genetic engineering is
   a) making artificial genes.
   b) hybridization of DNA of one organism to that of the others.
   c) production of alcohol by using micro organisms.
   d) making artificial limbs, diagnostic instruments such as ECG, EEG etc
5. Consider the following statements:
   I. Recombinant DNA technology is popularly known as genetic engineering is a stream of biotechnology which deals with the manipulation of genetic materials by man invitro
   II. pBR322 is the first artificial cloning vector developed in 1977 by Boliver and Rodriguez from E.coli plasmid
   III. Restriction enzymes belongs to a class of enzymes called nucleases.
   Choose the correct option regarding above statements
   a) I & II b) I & III c) II & III d) I, II & III
6. The process of recombinant DNA technology has the following steps
   I. amplication of the gene
   II. Insertion of recombinant DNA into the host cells
   III. Cutting of DNA at specific location using restriction enzyme .
   IV. Isolation of genetic material (DNA) Pick out the correct sequence of step for recombinant DNA technology.
   a) II, III, IV, I b) IV, II, III, I c) I, II, III, IV d) IV, III, I, II
7. Which one of the following palindromic base sequence in DNA can be easily cut at about the middle by some particular restriction enzymes?
   a) 5 CGTTCG 3 3 ATCGTA 5
   b) 5 GATATG 3 3 CTACTA 5
   c) 5 GAATTC 3 3 CTTAAG 5
   d) 5 CACGTA 3 3 CTCAGT 5
8. pBR 322, BR stands for Identify the correctly matched pair
   a) Plasmid Bacterial Recombination b) Plasmid Bacterial Replication
   c) Plasmid Boliver and Rodriguez d) Plasmid Baltimore and Rodriguez
9. Match the following

Column A		Column B	
1	Exonuclease	a)	add or remove phosphate
2	Endonuclease	b)	binding the DNA fragments
3	Alkaline Phosphatase	c)	cut the DNA at terminus
4	Ligase	d)	cut the DNA at middle

	1	2	3	4
(A)	a	b	c	d
(B)	c	d	b	a
(C)	a	c	b	d
(D)	c	d	a	b

10. In which techniques Ethidium Bromide is used?
    a) Southern Blotting techniques
    b) Western Blotting techniques
    c) Polymerase Chain Reaction
    d) Agrose Gel Electroporosis
11. **Assertion :** Agrobacterium tumifaciens is popular in genetic engineering because this bacterium is associated with the root nodules of all cereals and pulse crops
    Reason : A gene incorporated in the bacterial chromosomal genome gets atomatically transferred to the cross with which bacterium is associated
    a) Both assertion and reason are true. But reason is correct explanation of assertion.
    b) Both assertion and reason are true. But reason is not correct explanation of assertion.
    c) Assertion is true, but reason is false.
    d) Assertion is false, but reason is true.
    e) Both assertion and reason are false.
12. Which one of the following is not correct statement.
    a) Ti plasmid causes the bunchy top disease
    b) Multiple cloning site is known as Polylinker
    c) Non viral method transfection of Nucleic acid in cell
    d) Polylactic acid is a kind of biodegradable and bioactive thermoplastic
13. An analysis of chromosomal DNA using the southern hybridisation technique does not use
    a) Electrophoresis
    b) Blotting
    c) Autoradiography
    d) Polymerase Chain Reaction
14. An antibiotic gene in a vector usually helps in the selection of
    a) Competent cells
    b) Transformed cells
    c) Recombinant cells
    d) None of the above
15. Some of the characteristics of Bt cotton are
    a) Long fibre and resistant to aphids
    b) Medium yield, long fibre and resistant to beetle pests
    c) high yield and production of toxic protein crystals which kill dipteran pests.
    d) High yield and resistant to ball worms

2, 3, 5 Marks Questions

1. How do you use the biotechnology in modern practice?

- The use of the biotechnology in modern practice are
- Fermentation: Fermentation for production of acids, enzymes, alcohols, antibiotics, fine chemicals, vitamins and toxins.
- Bulk production of single cell protein, alcohol, and biofuel.
- Enzymes as biosensors, in processing industry
- Biofuels for production of hydrogen, alcohol, methane.
- Microbial inoculants as biofertiliser, and nitrogen fixers.
- Plant and animal cell culture for production of secondary metabolites, monoclonal antibodies.
- Recombinant DNA technology for production of fine chemicals, enzymes, vaccines, growth hormones, antibiotics, and interferon.
- Process engineering – tools of biotechnology is used for effluent treatment, water recycling.

2. What are the materials used to grow microorganism like Spirulina?

- Waste water from potato processing plants
- Straw
- Molasses
- Animal manure and even sewage.

3. You are working in a biotechnology lab with a becterium namely E.coli. How will you cut the nucleotide sequence? explain it.

- Eco R_1 is restriction enzymes isolated from E.coli bacterium.
- The enzyme recognise and cuts specific DNA sequence.
- Restriction endonuclease is an enzyme that cleaves DNA into fragments at or near specific recognition sites within the molecule known as restriction sites.
- Some cleave both strands of DNA through the centre resulting in blunt or flush end. These are known as symmetric cuts.
- Some enzymes cut in a way producing protruding and recessed ends known as sticky or cohesive end.
- Such cut are called staggered or asymmetric cuts.

4. What are the enzymes you can used to cut terminal end and internal phosphor di ester bond of nucleotide sequence?

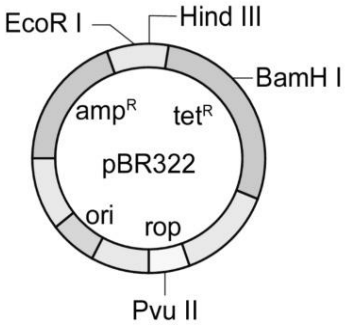
Exonucleases	It remove nucleotides one at a time from the end of a DNA molecule.	Ex : Bal 31, Exonuclease II
Endonucleases	It break the internal Phosphodiester bonds with Sin a DNA molecule.	EX : Hind II, EcoRI, Pvul, Bam H I, Taq I

5. Name the chemicals used in gene transfer.

- Polyethylene glycol (PEG)
- Dextran sulphate are the chemicals used in gene transfer.

6. What do you know about the word pBR332?

- pBR 322 plasmid is a reconstructed plasmid.
- It is most widely used as cloning vector.
- It contains 4361 base pairs.
- In pBR, p for plasmid, B and R for scientist Boliver and Rodriguez who developed this plasmid.
- The number 322 is the number of plasmid developed from their laboratory.
- It contains ampR and tetR two different antibiotic resistance genes.
- It is a recognition sites for several restriction enzymes (Hind III, EcoRI, BamH I, Sal I, Pvu II, Pst I, Cla I), ori and antibiotic resistance genes.
- Rop codes for the proteins involved in the replication of the plasmid.



amp^R - Ampicillin Resistance Gene

tet^R - Tetracycline Resistance Gene

7. Mention the application of Biotechnology.

- Biotechnology has wide applications in various sectors like agriculture, medicine, environment and commercial industries.
- This science has an invaluable outcome like transgenic varieties of plants
- Ex : Bt-cotton, rice, tomato, tobacco, cauliflower, potato and banana
- The development of transgenics as pesticide, stress and disease resistant varieties of agricultural crops is the outcome of biotechnology.
- The synthesis of human insulin and blood protein in E.coli .
- The synthesis of Vaccines, enzymes, antibiotics, dairy products and beverages are the products of biotech industries.
- Biochip based biological computer is one of the successes of biotechnology.
- Single cell protein from Spirulina is utilized in food industries.
- Production of secondary metabolites, biofertilizers, biopesticides and enzymes.
- Biomass energy, biofuel, Bioremediation, phytoremediation for environmental biotechnology.

8. What are restriction enzymes? Mention their type with role in Biotechnology.

- The two enzymes responsible for restricting the growth of bacteriophage in Escherichia coli were isolated in the year 1963.
- One was the enzyme which added methyl groups to DNA, while the other cut DNA. The latter was called restriction endonuclease.
- Restriction endonuclease is an enzyme that cleaves DNA into fragments at or near specific recognition sites within the molecule known as restriction sites.
- Based on their mode of action restriction enzymes are classified into
  - Exonucleases
  - Endonucleases.

Exonucleases	It remove nucleotides one at a time from the end of a DNA molecule.	Ex : Bal 31, Exonuclease II
Endonucleases	It break the internal Phosphodiester bonds with Sin a DNA molecule.	Ex : Hind II, EcoRI, Pvul, Bam H I, Taq I

Molecular scissors

- The restriction enzymes are called as molecular scissors.
- These act as foundation of recombinant DNA technology.
- There are three main classes of restriction endonucleases
  - Type I
  - Type II
  - Type III
- Which differ slightly by their mode of action.
- Type II enzyme is preferred for use in recombinant DNA technology.
- They recognise and cut DNA within a specific sequence typically consisting of 4-8 bp.
- The restriction enzyme Hind II always cut DNA molecules at a point of recognising a specific sequence of six base pairs. This sequence is known as recognition sequence.

- Today more than 900 restriction enzymes have been isolated from over 230 strains of bacteria with different recognition sequences.
- This sequence is referred to as a restriction site and is generally – palindromic which means that the sequence in both DNA strands at this site read same in 5' – 3' direction and in the 3'-5' direction.
- Ex : MALAYALAM: This phrase is read the same in either of the directions.
- Some cleave both strands of DNA through the centre resulting in blunt or flush end. These are known as symmetric cuts.
- Some enzymes cut in a way producing protruding and recessed ends known as sticky or cohesive end.
- Such cut are called staggered or asymmetric cuts.

9. Is their any possibilities to transfer a suitable desirable gene to host plant without vector ? Justify your answer.

- Yes.
- In the direct gene transfer methods, the foreign gene of interest is delivered into the host plant without the help of a vector.

Direct gene transfer

Chemical mediated gene transfer

- Certain chemicals like polyethylene glycol (PEG) and dextran sulphate induce DNA uptake into plant protoplasts.

Microinjection

- The DNA is directly injected into the nucleus using fine tipped glass needle or micro pipette to transform plant cells.

Electroporation Methods

- A pulse of high voltage is applied to protoplasts, cells or tissues which makes transient pores in the plasmamembrane through which uptake of foreign DNA occurs.

Liposome mediated method of Gene Transfer

- Liposomes the artificial phospholipid vesicles are useful in gene transfer.
- The gene or DNA is transferred from liposome into vacuole of plant cells.
- It is carried out by encapsulated DNA into the vacuole.
- Liposome and tonoplast of vacuole fusion resulted in gene transfer.
- This process is called lipofection.

Biolistics

- The foreign DNA is coated onto the surface minute gold or tungsten particles (1-3 μm) and bombarded onto the target tissue or cells using a particle gun (also called as gene gun / micro projectile gun / shotgun.
- Then the bombarded cells or tissues are cultured on selected medium to regenerate plants from the transformed cells.

10. How will you identify a vectors?

- Vectors are able to replicate autonomously to produce multiple copies of them along with their DNA insert in the host cell.
- It should be small in size and of low molecular weight, less than 10 Kb in size. so that entry into host cell is easy.
- Vector must contain an origin of replication so that it can independently replicate within the host.
- Vector should have unique target sites for integration with DNA insert
- It should have the ability to integrate with DNA insert it carries into the genome of the host cell.
- Most of the commonly used cloning vectors have more than one restriction site. These are Multiple Cloning Site (MCS) or polylinker.
- Presence of MCS facilitates the use of restriction enzyme of choice.

11. Write the advantages and disadvantages of Bt cotton.

Advantages

- Yield of cotton is increased due to effective control of bollworms.
- Reduction in insecticide use in the cultivation of Bt cotton.
- Potential reduction in the cost of cultivation.

Disadvantages

- Cost of Bt cotton seed is high.
- Effectiveness up to 120 days after that efficiency is reduced.
- Ineffective against sucking pests like jassids, aphids and whitefly.
- Affects pollinating insects and thus yield.

12. Compare the various types of Blotting techniques.

	Southern blotting	**Northern blotting**	**Western blotting**
Name	Southern name of the inventor	Northern a misnomer	Western a misnomer
Separation of	DNA	RNA	Proteins
Denaturation	Needed	Not needed	Proteins
Membrane	Nitrocellulose / nylon	Amino benzyloxy methyl	Nitrocellulose
Hybridisation	DNA-DNA	RNA-DNA	Protein - antibody
Visualising	Autoradiogram	Autoradiogram	Dark room

13. Write the advantages of herbicide tolerant crops.

- Weed control improves higher crop yields.
- Reduces spray of herbicide.
- Reduces competition between crop plant and weed.
- Use of low toxicity compounds which do not remain active in the soil
- The ability to conserve soil structure and microbes.

14. What is bioremediation? Give some examples of bioremediation.

- The use of microorganisms or plants to clean up environmental pollution is called bioremediation.
- It is used in wastewater, industrial waste and solid waste.
- Bioremediation process applied to the removal of oil, petrochemical residues, pesticides or heavy metals from soil or ground water.

Some examples of bioremediation technologies are

Phytoremediation

- use of plants to bring about remediation of environmental pollutants.

Mycoremediation

- use of fungi to bring about remediation of environmental pollutants.

Bioventing

- Increases the oxygen or air flow to accelerate the degradation of environmental pollutants.

Bioleaching

- Use of microorganisms in solution to recover metal pollutants from contaminated sites.

Bioaugmentation

- A addition of selected microbes to speed up degradation process.

Composting

- The solid waste is composted by the use of microbes into manure .
- Which acts as a nutrient for plant growth.

Rhizofiltration

- The uptake of metals or organic compounds by rhizosphere microorganisms.

Rhizostimulation

- The stimulation of plant growth by the rhizosphere by providing better growth condition or reduction in toxic materials.

15. Write the benefits and risk of Genetically Modified Foods.

GM Food - Benefits

- High yield without pest
- 70% reduction of pesticide usage
- Reduce soil pollution problem
- Conserve microbial population in soil.

Risk – Belived to

- Affect liver, kidney function and cancer.
- Hormonal imbalance and physical disorder.
- Anaphylactic shock (sudden hypersensitive reaction) and allergies.
- Adverse effect in immune system because of bacterial protein.
- Loss of viability of seeds show in terminator seed technology of GM crops.

Additional Questions

16. Define : plasmid

- Plasmids are extra chromosomal, self replicating ds circular DNA molecules, found in the bacterial cells.
- Plasmids contain Genetic information for their own replication.

17. Write note on Ti – plasmid.

- Ti plasmid is found in Agrobacterium tumefaciens, a bacterium responsible for inducing tumours in dicot plants.
- The plasmid carries transfer (tra) gene.
- Which help to transfer T-DNA from one bacterium to other bacterial or plant cell.
- Ti – plasmids have been used for introduction of genes of desirable traits into plants.

18. Define: Single cell protein (SCP).

- The dried cells of microorganisms that are used as protein supplement in human foods or animal feeds are called Single cell proteins.

Applications of Single-Cell Protein

- It is used as protein supplement.
- It is used in cosmetics products for healthy hair and skin.
- It is used as the excellent source of proteins for feeding cattle, birds, fishes etc.
- It is used in industries like paper processing, leather processing as foam stabilizers.
- It is used in food industry as aroma carriers, vitamin carrier, emulsifying agents to improve the nutritive value of baked products, in soups, in ready-to-serve-meals, in diet recipes.

19. Name the microorganisms used as of SCP.

Bacteria

- Methylophilus , methylotrophus, Cellulomonas, Alcaligenes

Fungi

- Agaricus campestris, Saccharomyces cerevisiae (yeast), Candida utilis

Algae

- Spirulina, Chlorella, Chlamydomonas.

20. E.coli is the most widely used organism for vectors. Give reasons.

- Its genetic make-up has been extensively studied.
- It is easy to handle and grow.
- It can accept a range of vectors and has also been studied for safety.
- E.coli to be preferred as a host cell because under optimal growing conditions the cells divide every 20 minutes.

21. Describe Flavr Savr Tomato.

- It is transgenic tomato variety which has blocked production of polygalactronase is called FlavrSavr.
- Agrobacterium mediated genetic engineering technique produce Flavr-Savr tomato.
- This retaining the natural colour and flavor of tomato.
- Through genetic engineering, the ripening process of the tomato is slowed down. and thus prevent from softening and to increase the shelf life.
- The tomato was made more resistant to rotting by Agrobacterium mediated gene transfer mechanism of introducing an antisense gene
- It produce the enzyme polygalacturonase.
- It helps in delaying the ripening process of tomato during long storage and transportation.

22. Describe Golden rice – biofortification.

- Golden rice is a variety of Oryza sativa produced through genetic engineering.
- It is developed by Ingo Potrykus and his group.
- The aim is to produce a fortified food to be grown and consumed in areas with a shortage of dietary Vitamin-A.
- Golden rice differs from its parental by the addition of three beta-carotene biosynthesis genes.
  - Psy gene
  - crt-1 gene
  - lyc gene
- The endosperm of normal rice, does not contain beta-carotene.
- Golden-rice has been genetically altered so that the endosperm now accumulates Beta-carotene.
- This has been done using Recombinant DNA technology.
- Golden rice can control childhood blindness – Xerophthalmia.

23. Name the tools used as genetic engineering.

- Restriction enzymes
- DNA ligase
- Alkaline phosphatase.

24. What is Genome?

- The whole complement of gene that determine all characteristic of an organism is called genome.

25. What is Biopharming ?

- Biopharming also known as molecular pharming.
- It is the production and use of transgenic plants genetically engineered to produce pharmaceutical substances for use of human beings. This is also called biopharming

26. What is Bioprospecting ?

- It is the process of discovery and commercialization of new products obtained from biological resources is called Bioprospecting.

27. What is Biopiracy?

- It can be defined as the manipulation of intellectual property rights laws by corporations to gain exclusive control over national genetic resources, without giving adequate recognition or remuneration to the original possessors of those resources.
- Ex: Recent patents granted by the U.S. Patent and Trademarks Office to American companies on turmeric, neem and basmati rice.

28. Explain the method of biological hydrogen production by algae.

- The biological hydrogen production with algae is a method of photo biological water splitting.
- In normal photosynthesis the alga, Chlamydomonas reinhardtii releases oxygen.
- When it is deprived of sulfur, it switches to the production of hydrogen during photosynthesis and the electrons are transported to ferredoxins.
- (Fe) - hydrogenase enzymes combine them into the production of hydrogen gas.

29. Explain about the Biopiracy of neem.

- The people of India used neem and its oil in many ways to controlling fungal and bacterial skin infections.
- Indian's have shared the knowledge of the properties of the neem with the entire world.
- The United States Department of Agriculture (USDA) and an American MNC W.R.Grace in the early 90's sought a patent from the European Patent Office (EPO).
- The method for controlling of diseases on plants by the aid of extracted hydrophobic neem oil.
- The patenting of the fungicidal and antibacterial properties of neem was an example of biopiracy.
- But the traditional knowledge of the Indians was protected in the end.

30. Explain about the Biopiracy of turmeric ? How the turmeric US patent was cancelled ?

- The United States Patent and Trademark Office, in the year 1995 granted patent to the method of use of turmeric as an antiseptic agent.
- Turmeric is the Indians as a home remedy for the quick healing of the wounds and also for purpose of healing rashes.
- The journal article published by the Indian Medical Association, in the year 1953 proved that the use of turmeric as an antiseptic is not new to the world and is not a new invention, but formed a part of the traditional knowledge of the Indians.
- The objection in this case US patent and trademark office was upheld and traditional knowledge of the Indians was protected.
- It is another example of Biopiracy.

31. Explain about the Biopiracy of Basmati.

- On September 2, 1997, the U.S. Patent and Trademarks Office granted Patent on "basmati rice lines and grains" to the Texas-based company RiceTec.
- This broad patent gives the company several rights, including exclusive use of the term 'basmati', as well proprietary rights on the seeds and grains from any crosses.
- The patent also covers the process of breeding RiceTec's novel rice lines and the method to determine the cooking properties and starch content of the rice grains.
- India had periled the United States to take the matter to the WTO as an infringement of the TRIPS agreement, which could have resulted in major embarrassment for the US.
- Hence voluntarily and due to few decisions take by the US patent office, Rice Tec had no choice but to lose most of the claims and most importantly the right to call the rice "Basmati".
- In the year 2002, the final decision was taken. Rice Tec dropped down 15 claims, resulting in clearing the path of Indian Basmati rice exports to the foreign countries.
- The Patent Office ordered the patent name to be changed to 'Rice lines 867'.

32. Describe herbicide tolerant – basta.

- Trade name Basta' refers herbicide containing the chemical compound phosphinothricin.
- Basta herbicide tolerant gene PPT was isolated from Medicago sativa plant.
- It inhibits the enzyme glutamine synthase which is involved in ammonia assimilation.
- The PPT gene was introduced into tobacco.
- Transgenic tobacco produced was resistant to PPT.
- Similar enzyme was also isolated from Streptomyces hygroscopicus with bar gene encodes for PAT.
- It was introduced into crop plants like potato and sugar-beet and transgenic crops have been developed.

33. Why do we call Agrobacterium tumefaciens as the natural genetic engineer of plants. What could be the reason ?

- This bacterium has a large size plasmid, known as Ti plasmid.
- This bacterium has the natural ability to transfer T-DNA region of its plasmid into plant genome, upon infection of cells at the wound site.
- So it is known as the natural genetic engineer of plants.

34. What is meant by zymology ?

- The study of fermentation and its practical uses is called zymology.

35. What is Green Fluorescent Protein (GFP) ?

- The green fluorescent protein (GFP) is a protein containing 238 amino acid residues of 26.9 kDa
- It exhibits bright green fluorescence when exposed to blue to ultraviolet range.
- GFP is an excellent tool in biology due to its ability to form internal chromophore without requiring any accessory cofactors, gene products, enzymes or substrates other than molecular oxygen.

36. What is Bio-reactor (Fermentor) ?

- Bioreactor is a vessel or a container.
- It is designed that it can provide an optimum environment in which microorganisms or their enzymes interact with a substrate to produce the required product.
- In the bioreactor aeration, agitation, temperature and pH are controlled.

37. What is algal fuel ?

- Algal fuel, also known as algal biofuel.
- It is an alternative to liquid fossil fuels.
- Botryococcus braunii is normally used to produce algal biofuel.

38. Differentiate between upstream & downstream process.

S.No	Upstream process	Downstream process
1 .	All the process of preparation before the starting the fermenter.	All the process after the fermentation process.
2 .	Includes sterilization of the fermentor, preparation and sterilization of culture medium and growth of the suitable inoculum .	Includes distillation, centrifuging , filteration and solvent extraction .

39. Expain the mechanism of Agarose gel Electrophoresis

- It is used mainly for the purification of specific DNA fragments.
- Agarose is convenient for separating DNA fragments ranging in size from a few hundred to about 20000 base pairs.
- Polyacrylamide is preferred for the purification of smaller DNA fragments.
- The gel is complex network of polymeric molecules.
- DNA molecule is negatively charged molecule - under an electric field DNA molecule migrates through the gel.
- The electrophoresis is frequently performed with marker DNA fragments of known size which allow accurate size determination of an unknown DNA molecule by interpolation.
- The bands of DNA in the gel are stained with the dye Ethidium Bromide and DNA can be detected as visible fluorescence illuminated in UV light will give orange fluorescence, which can be photographed.

Lesson – 5 Plant Tissue culture

1. Totipotency refers to
   a) capacity to generate genetically identical plants.
   b) capacity to generate a whole plant from any plant cell / explant.
   c) capacity to generate hybrid protoplasts.
   d) recovery of healthy plants from diseased plants.
2. Micro propagation involves
   a) vegetative multiplication of plants by using micro-organisms.
   b) vegetative multiplication of plants by using small explants.
   c) vegetative multiplication of plants by using microspores.
   d) Non-vegetative multiplication of plants by using microspores and megaspores.
3. Match the following

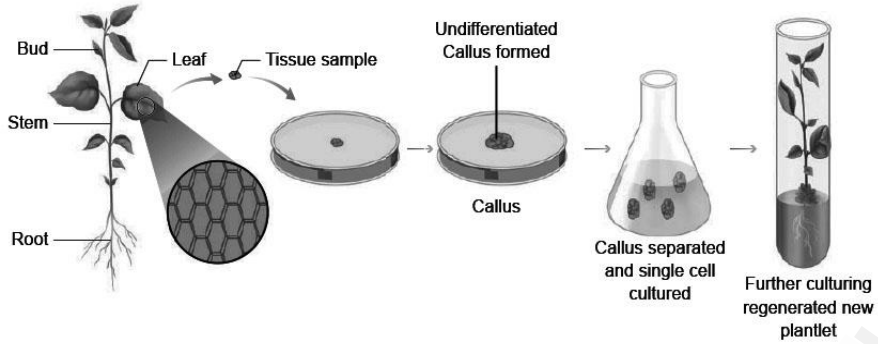
Column A		Column B	
1)	Totipotency	A)	Reversion of mature cells into meristerm
2)	Dedifferentiation	B)	Biochemical and structural changes of cells
3)	Explant	C)	Properties of living cells develops into entire plant
4)	Differentiation	D)	Selected plant tissue transferred to culture medium

	1	2	3	4
(A)	C	A	D	B
(B)	A	C	B	D
(C)	B	A	D	C
(D)	D	B	C	A

4. The time duration for sterilization process by using autoclave is ___minutes and the temperature is ___
   a) 10 to 30 minutes and 125° C
   b) 15 to 30 minutes and 121° C
   c) 15 to 20 minutes and 125° C
   d) 10 to 20 minutes and 121° C
5. Which of the following statement is correct
   a) Agar is not extracted from marine algae such as seaweeds.
   b) Callus undergoes differentiation and produces somatic embryoids.
   c) Surface sterilization of explants is done by using mercuric bromide
   d) PH of the culture medium is 5.0 to 6.0
6. Select the incorrect statement from givenstatement
   a) A tonic used for cardiac arrest is obtained from Digitalis purpuria
   b) Medicine used to treat Rheumatic pain is extracted from Capsicum annum
   c) An anti malarial drug is isolated from Cinchona officinalis.
   d) Anti-cancinogenic property is not seen in Catharanthus roseus.
7. Virus free plants are developed from
   a) Organ culture
   b) Meristem culture
   c) Protoplast culture
   d) Cell suspension culture
8. The prevention of large scale loss of biological interity
   a) Biopatent
   b) Bioethics
   c) Biosafety
   d) Biofuel
9. Cryopreservation means it is a process to preserve plant cells, tissues or organs
   a) at very low temperature by using ether.
   b) at very high temperature by using liquid nitrogen
   c) at very low temperature of -196 by using liquid nitrogen
   d) at very low temperature by using liquid nitrogen
10. Solidifying agent used in plant tissue culture is
    a) Nicotinic acid
    b) Cobaltous chloride
    c) EDTA
    d) Agar

2, 3, 5 Marks Questions

1. What is the name of the process given below? Write its 4 types.



Name :

- Plant tissue culture technology.

Types :

- Isolation of cells
- Culture condition
- Induction of callus
- Embryogenesis.

2. How will you avoid the growing of microbes in nutrient medium during culture process? What are the techniques used to remove the microbes?

- Using sterilization method to avoid the growth of microbes in nutrient medium.

Techniques

- Culture media are dispensed in glass containers, plugged with non-absorbent cotton or sealed with plastic closures.
- Then sterilized using autoclave at 15 psi (121°C) for 15 to 30 minutes.
- The plant extracts, vitamins, amino acids and hormones are sterilized by passing through Millipore filter with 0.2 mm pore diameter.
- Then added to sterilized culture medium inside Laminar Airflow Chamber under sterile condition.

3. Write the various steps involved in cell suspension culture.

- Culture of single cells or small aggregates of cells in vitro in liquid medium is called cell suspension culture.
- The cell suspension is prepared by transferring a portion of callus to the liquid medium and agitated using rotary shaker instrument.
- The cells are separated from the callus tissue and used for cell suspension culture.

4. What do you mean Embryoids? Write its application.

- The formation of embryos from the callus tissue directly are called somatic embryogenesis.
- Somatic embryos is also known as Embryoids.

Applications

- somatic embryogenesis provides potential plantlets which after hardening period can establish into plants.
- Somatic embryoids can be used for the production of synthetic seeds.
- Somatic embryogenesis is now reported in many plants.
- Example: Allium sativum, Hordeum vulgare, Oryza sativa, Zea mays.

5. Give the examples for micro propagation performed plants.

- Pineapple,
- Banana,
- Strawberry
- Potato.

6. Explain the basic concepts involved in plant tissue culture.

- Basic concepts of plant tissue culture are
  - Totipotency
  - Differentiation
  - dedifferentiation
  - redifferentiation

Totipotency

- The property of live plant cells that they have the genetic potential when cultured in nutrient medium to give rise to a complete individual plant.

Differentiation

- The process of biochemical and structural changes by which cells become specialized in form and function.
- Meristematic tissue into mature cells.

Dedifferentiation

- The reversion of mature cells to the meristematic state leading to the formation of callus is called dedifferentiation.
- Mature cells into the meristematic tissue.
- Formation of callus is called dedifferentiation.

Redifferentiation

- The component cells of callus have the ability to form a whole plant in a nutrient medium is called redifferentiation.

7. Based on the material used, how will you classify the culture technology? Explain it.

- Based on the explants the culture technology types are
  - Organ culture
  - Meristem culture
  - Protoplast culture
  - Cell culture.

Organ culture

- The culture of embryos, anthers, ovaries, roots, shoots or other organs of plants on culture media is called organ culture.

Meristem Culture

- The culture of any plant meristematic tissue on culture media.

Protoplast Culture

- Protoplasts are cells without a cell wall, but bound by a cell membrane or plasmamembrane.
- Using protoplasts, regenerate whole plants from single cells and also develop somatic hybrids.

Cell Suspension Culture

- Culture of single cells or small aggregates of cells in vitro in liquid medium is called cell suspension culture.
- The cell suspension is prepared by transferring a portion of callus to the liquid medium and agitated using rotary shaker instrument.
- The cells are separated from the callus tissue and used for cell suspension culture.

8. Give an account on Cryopreservation.

- Crysopreservation also known as Cryo - conservation.
- The protoplasts, cells, tissues, organelles, organs, extracellular matrix, enzymes or any other biological materials are preserved in a very low temperature of –196°C by using liquid nitrogen are called cryopreservation.
- At this extreme low temperature any enzymatic or chemical activity of the biological material will be totally stopped.
- Later these materials can be activated by bringing to room temperature slowly for any experimental work.
- Protective agents like dimethyl sulphoxide, glycerol or sucrose are added before cryopreservation process. These Protective agents are called cryoprotectants.

9. What do you know about Germplasm conservation. Describe it.

- Living genetic resources such as pollen, seeds or plant tissue materials are preserved in living condition for future use for many research works.
- It maintained for the purpose of selective plant breeding, preservation in live condition.
- Germplasam conservation is a part of collection of seeds and pollen that are stored in seed or pollen banks.
- So as to maintain their viability and fertility for any later use. Example: Hybridization and crop improvement.
- It may also involve a gene bank, DNA bank of elite breeding lines of plant resources for the maintenance of biological diversity and also for food security.

10. Write the protocol for artificial seed preparation.

- Artificial seeds or synthetic seeds are produced by using embryoids obtained through in vitro culture.
- They may even be derived from single cells from any part of the plant.
- Later divide to form cell mass containing dense cytoplasm, large nucleus, starch grains, proteins, and oils etc
- To prepare the artificial seeds different inert materials are used for coating the somatic embryoids like agrose and sodium alginate.

Additional Questions

11. Write the definitions of Tissue Culture.

- Growing plant protoplasts, cells, tissues or organs away from their natural or normal environment, under artificial condition, is known as tissue Culture.

12. What is Sterilization?

- Is the technique employed to get rid of microbes such as bacteria and fungi in the culture medium, vessels and explants are called Sterilization.

13. Name few culture media used for plant tissue culture technique.

- MS nutrient medium
- B5 medium
- White medium
- Nitsch's medium.

14. What is explant ?

- The tissue taken from a selected plant transferred to a culture medium often to establish a new plant.

15. What is known as cell suspension culture ?

- The culture of single cells or aggregates of cells in vitro in liquid medium is known as cell suspension culture.

16. Describe hardening ?

- The plantlets developed in vitro are transferred to greenhouse or hardening chamber.
- Then the plantlets expose to normal environmental conditions.

17. What is somatic embryogenesis ?

- The formation of embryos from the callus tissue directly are called somatic embryogenesis.
- Somatic embryos is also known as Embryoids.

18. What is cybrid ?

- The fusion product of protoplasts without nucleus of different cells is called a cybrid.

19. What is PEG ?

- PEG - Polyethylene Glycol.
- It is suitable fusogenic agent in protoplast culture along with Ca++ ions.

20. Write short note on Intellectual property right (IPR).

- IPR is a category of property that includes intangible creation of the human intellect, and primarily consists of copyrights, patents, and trademarks.
- It also includes other types of rights, such as trade secrets, publicity rights, moral rights, and rights against unfair competition.

21. What is Bioethics ?

- The study of ethical issues emerging from advances in biology and medicine is called bioethics.
- It is also a moral discernment as it relates to medical policy and practice.

22. Define : Biosafety.

- Biosafety is the prevention of large-scale loss of biological integrity, focusing both on ecology and human health are called Biosafety.

23. What does the term patent represent ? What are the three parts of the patent ?

- It is a special right to the discoverer / Inventor that has been granted by government.
- It can be licensed or sold by a person or an organization.
- A patent consists of three parts: the grant, specifications and claims.

The grant

- It is filled at the patent office which is not published.
- It is a signed document, actually the agreement that grants patent right to the inventor.

The specification

- The specification and claims are published as a single document which is made public from the patent office.
- The specification part is narrative in which the subject matter of invention is described as how the invention was carried out.

The claim

- It is specifically defines the scope of the invention to be protected by the patent which the others may not practice.

24. Give few industrially important plant secondary metabolites and their uses.

Secondary metabolites	Plant source	Uses
Digoxin	Digitalis purpuria	Cardiac tonic
Codeine	Papaver sominiferum	Analgesic
Capsaicin	Capsicum annum	Rheumatic pain treatment
Vincristine	Catharanthus roseus	Anti-carcinogenic
Quinine	Cinchona officinalis	Antimalarial

25. Write the applications of Plant tissue culture

- Improved hybrids production through somatic hybridization.
- Somatic embryoids produce synthetic seeds. These synthetic seeds help in conservation of plant biodiversity.
- Production of disease resistant plants through meristem and shoot tip culture.
- Production of stress resistant plants like herbicide tolerant, heat tolerant plants.
- Micropropagation technique to obtain both crop and tree species. It is useful in forestry within a short span of time and all through the year.
- Production of secondary metabolites from cell culture utilized in pharmaceutical, cosmetic and food industries.

26. Write few advantages of artificial seeds.

- Artificial seeds have many advantages over the true seeds.
- Millions of artificial seeds can be produced at any time at low cost.
- They provide an easy method to produce genetically engineered plants with desirable traits.
- It is easy to test the genotype of plants.
- They can potentially store for long time under cryopreservation method.
- Artificial seeds produce identical plants.
- The period of dormancy is greatly reduced and growth is faster with a shortened life cycle.

27. Differentiate somaclonal variation from Gametoclonal variations.

S.No	Somaclonal variations	Gametoclonal variations
1.	Somatic variations found in plants regenerated in vitro.	Gametophytic variations found in plants regenerated in vitro gametic orgin.
2.	Variations found in leaf, stem, root , tuber.	Variations found in gametes and gametophytes.

28. What are the steps involved in protoplast culture ?

- The steps involved in protoplast culture.

Isolation of protoplast

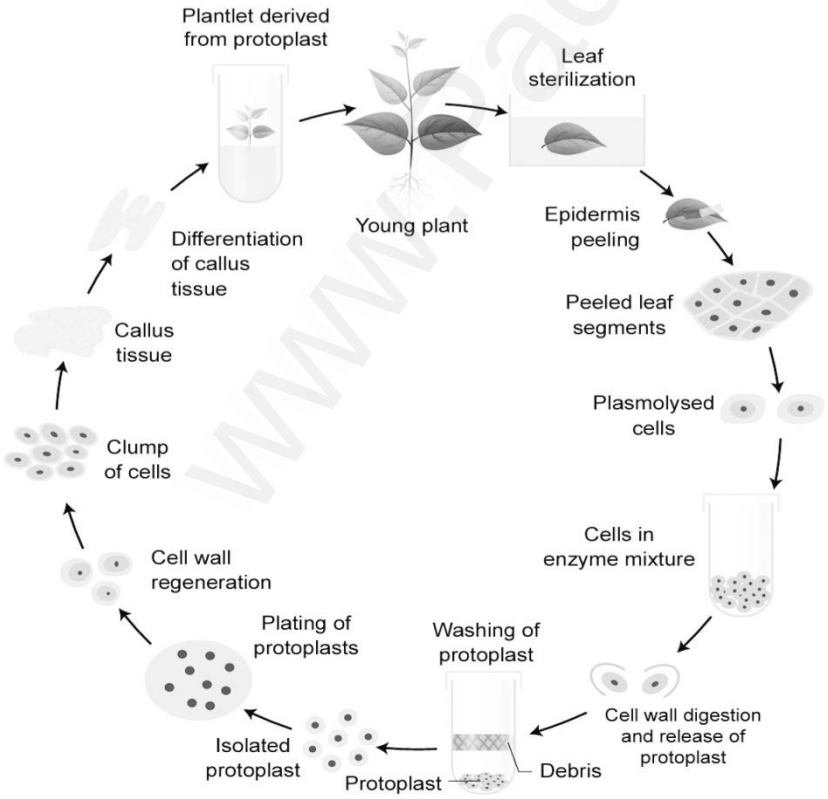
- The leaf tissue are used for isolation of protoplast.
- Leaf tissue is immersed in 0.5% Macrozyme and 2% Onozuka cellulase enzymes dissolved in 13% sorbitol or mannitol at pH 5.4.
- It is then incubated over-night at 25°C.
- After a gentle teasing of cells, protoplasts are obtained.
- These are then transferred to 20% sucrose solution to retain their viability.
- They are then centrifuged to get pure protoplasts as different from debris of cell walls.

Fusion of protoplast

- PEG - Polyethylene Glycol.
- It is suitable fusogenic agent in protoplast culture along with Ca++ ions.
- The isolated protoplasts are incubated in 25 to 30% concentration of PEG with Ca++ ions.
- The protoplast shows agglutination and fusion.

Culture of protoplast

- MS liquid medium is used with some modification in droplet, plating or micro-drop array techniques.
- Protoplast viability is tested with fluorescein diacetate before the culture.
- The cultures are incubated in continuous light 1000-2000 lux at 25°C.
- The cell wall formation occurs within 24-48 hours.
- The first division of new cells occurs between 2-7 days of culture.



29. Explain the sterilization methods used during the plant tissue culture.

Sterilization

- Is the technique employed to get rid of microbes such as bacteria and fungi in the culture medium, vessels and explants are called Sterilization.

Maintenance of Aseptic Environment

- Sterilization of glassware, forceps, scalpels, and all accessories in wet steam sterilization by autoclaving at 15 psi (121°C) for 15 to 30 minutes.
- Otherwise dipping in 70% ethanol followed by flaming and cooling.

Sterilization of culture room

- Floor and walls are washed first with detergent.
- Then washed with 2% sodium hypochlorite or 95% ethanol.
- The cabinet of laminar airflow is sterilized by clearing the work surface with 95% ethanol
- Then exposure of UV radiation for 15 minutes.

Sterilization of Nutrient Media

- Culture media are dispensed in glass containers, plugged with non-absorbent cotton or sealed with plastic closures.
- Then sterilized using autoclave at 15 psi (121°C) for 15 to 30 minutes.
- The plant extracts, vitamins, amino acids and hormones are sterilized by passing through Millipore filter with 0.2 mm pore diameter.

Sterilization of Explants

- The plant materials surface sterilized by first exposing the material in running tap water
- Then treating with sterilization agents like 0.1% mercuric chloride, 70% ethanol under aseptic condition inside the Laminar Air Flow Chamber.

30. List out the laboratory facilities of plant tissue culture.

- Washing facility for glassware
- Ovens for drying glassware.
- Autoclave
- Electronic balance
- Ph meter
- Sterile room with laminar air flow

Culture facility :

- 22-28^{0}C with illumination of light, 2400 lux.
- 8-16 hours photoperiod, 60% humidity.

Lesson – 6 Principles of Ecology

1. Arrange the correct sequence of ecological hierarchy starting from lower to higher level.
   a) Individual organism → Population Landscape → Ecosystem
   b) Landscape → Ecosystem → Biome → Biosphere
   c) Community → Ecosystem → Landscape → Biome
   d) Population → organism → Biome → Landscape
2. Ecology is the study of an individual species is called
   i) Community ecology ii) Autecology iii) Species ecology iv) Synecology
   a) i only b) ii only c) i and iv only d) ii and iii only
3. A specific place in an ecosystem, where an organism lives and performs its functions is
   a) habitat b) niche c) landscape d) biome
4. Read the given statements and select the correct option.
   i) Hydrophytes possess aerenchyma to support themselves in water.
   ii) Seeds of Viscum are positively photoblastic as they germinate only in presence of light.
   iii) Hygroscopic water is the only soil water available to roots of plant growing in soil as it is present inside the micropores.
   iv) High temperature reduces use of water and solute absorption by roots.
   a) i, ii, and iii only b) ii, iii and iv
   c) ii and iii only d) i and ii only
5. Which of the given plant produces cardiac glycosides?
   a) Calotropis b) Acacia c) Nepenthes d) Utricularia
6. Read the given statements and select the correct option.
   i) Loamy soil is best suited for plant growth as it contains a mixture of silt, sand and clay.
   ii) The process of humification is slow in case of organic remains containing a large amount of lignin and cellulose**.**
   iii) Capillary water is the only water available to plant roots as it is present inside the micropores.
   iv) Leaves of shade plant have more total chlorophyll per reaction centre, low ratio of chl a and chl b are usually thinner leaves.
   a) i, ii and iii only b) ii, iii and iv only
   c) i, ii and iv only d) ii and iii only.
7. Read the given statements and select the correct option.
   Statement A : Cattle do not graze on weeds of Calotropis.
   Statement B : Calotropis have thorns and spines, as defense against herbivores.
   a) Both statements A and B are incorrect.
   b) Statement A is correct but statement B is incorrect.
   c) Both statements A and B are correct but statement B is not the correct explanation of statement A.
   d) Both statements A and B are correct and statement B is the correct explanation of statement A.
8. In soil water available for plants is
   a) gravitational water b) chemically bound water
   c) capillary water d) hygroscopic water
9. Read the following statements and fill up the blanks with correct option.
   i) Total soil water content in soil is called _____
   ii) Soil water not available to plants is called _____
   iii) Soil water available to plants is called _____

	(i)	(ii)	(iii)
(a)	Holard	Echard	Chresard
(b)	Echard	Holard	Chresard
(c)	Chresard	Echard	Holard
(d)	Holard	Chresard	Echard

10. Column I represent the size of the soil particles and Column II represents type of soil components**.** Which of the following is correct match for the Column I and Column II

Column – I		**Column - II**	
I)	0.2 to 2.00	i)	Silt soil
II)	Less than 0.002 mm	ii)	Clayey soil
III)	0.002 to 0.02 mm	iii)	Sandy soil
IV)	0.002 to 0.2 mm	iv)	Loamy soil

	I	**II**	**III**	**IV**
(a)	Ii	iii	Iv	I
(b)	Iv	i	Iii	Ii
(c)	Iii	ii	I	Iv
(d)	None of the above			

11. The plant of this group are adapted to live partly in water and partly above substratum and free from water
    a) Xerophytes b) Mesophytes c) Hydrophytes d) Halophytes
12. Identify the A, B, C and D in the given table

Interaction	**Effects on species X**	**Effects on species Y**
Mutualism	A	(+)
B	(+)	(-)
Competition	(-)	C
D	(-)	0

	A	**B**	**C**	**D**
(a)	(+)	Parasitism	(-)	Amensalism
(b)	(-)	Mutalism	(+)	Competition
(c)	(+)	Competition	(0)	Mutalism
(d)	(0)	Amenasalism	(+)	Parasitism

13. Ophrys an orchid resembling the female of an insect so as to able to get pollinated is due to phenomenon of
    a) Myrmecophily b) Ecological equivalents
    c) Mimicry d) None of these
14. A free living nitrogen fixing cyanobacterium which can also form symbiotic association with the water fern Azolla
    a) Nostoc b) Anabaena c) chlorella d) Rhizobium
15. Pedogenesis refers to
    a) Fossils b) Water c) Population d) Soil
16. Mycorrhiza promotes plant growth by
    a) Serving as a plant growth regulators
    b) Absorbing inorganic ions from soil
    c) Helping the plant in utilizing atmospheric nitrogen
    d) Protecting the plant from infection.
17. In a fresh water environment like pond, rooted autotrophs are
    a) Nymphaea and typha b) Ceratophyllum and Utricularia
    c) Wolffia and pistia d) Azolla and lemna

18. Match the following and choose the correct combination from the options given below

Column – I (Interaction)		**Column - II Examples**	
I)	Mutualism	i)	Trichoderma and Penicillum
II)	Commensalism	ii)	Balanophora, Orobanche
III)	Parasitism	iii)	Orchids and Ferns
IV)	Predation	iv)	Lichen and Mycorrhiza
V)	Amensalism	iv)	Nepanthes and Diaonaea

	I	**II**	**III**	**IV**	**V**
(a)	i	Ii	iii	Iv	V
(b)	ii	Iii	iv	V	i
(c)	iii	Iv	v	I	ii
(d)	iv	Iii	ii	V	i

19. Sticky glands of Boerhaavia and Cleome support

a) Anemochory b) Zoochory

c) Autochory d) Hydrochory

2, 3, 5 Marks Questions

1. Define ecology.

- The study of living organisms, both plants and animals, in their natural habitats or homes. - Reiter

2. What is ecological hierarchy? Name the levels of ecological hierarchy.

- The interaction of organisms with their environment results in the establishment of grouping of organisms is called ecological hierarchy**.**

Bioshere
⇧
Biome
⇧
Landscape
⇧
Ecosystem
⇧
Community
⇧
population
⇧
Indidual organism

3. What are ecological equivalents? Give one example.

- Taxonomically different species occupying similar habitats in different geographical regions are called ecological equivalents**.**

Ex :

- Certain species of epiphytic orchids of Western Ghats of India differ from the epiphytic orchids of South America. But they are epiphytes.

4. Distinguish habitat and niche.

Habitat	Niche
A specific physical space occupied by an organism.	A functional space occupied by an organism in the same eco-system
Same habitat may be shared by many Organisms.	A single niche is occupied by a single species
Habitat specificity is exhibited by organism.	Organisms may change their niche with time and season.

5. Why are some organisms called as eurythermals and some others as stenohaline?

- Based on the range of thermal tolerance, organisms are divided into eurythermals and stenothermals.

Eurythermal

- Organisms which can tolerate a wide range of temperature fluctuations.
- Example : Zostera

Stenothermal

- Organisms which can tolerate only small range of temperature variations.
- Example : Mango
- Mango plant does not grow in temperate countries like Canada and Germany.

6. 'Green algae are not likely to be found in the deepest strata of the ocean'. Give at least one reason.

- Green algae is not found in deepest strata of ocean because of absence of light.

7. What is Phytoremediation ?

- The plants soya bean, tomato, rice and Eichhornia can be used to remove cadmium from contaminated soil, and this make suitable for cultivation is known as Phytoremediation.

8. What is Albedo effect and write their effects?

- An aerosol with small particles is reflecting the solar radiation entering the atmosphere. This is known as albedo effect.

Effects

- It reduces the temperature, photosynthesis and respiration.

9. The organic horizon is generally absent from agricultural soils. Why is an organic horizon generally absent in desert soils ?

- A desert has little or no plants.
- So no organic materials are present in the soil.
- As a result there is no organic horizon present in the desert soil.

10. Soil formation can be initiated by biological organisms. Explain how?

- Soil formation is initiated by weathering process.
- The organisms like bacteria, fungi, lichens and plants acids produce certain chemical substances.
- It helps in the breakdown of rocks and originates the soil.

11. Sandy soil is not suitable for cultivation. Explain why?

- Sandy soil particles are larger, low water holding capacity and poor organic content. So it cannot hold the water.
- So this soil is not suitable for cultivation.

12. Describe the mutual relationship between the fig and wasp and comment on the phenomenon that operates in this relationship.

- The relationship between fig tree and wasp shows mutualism.
- The female wasp pollinating the fig, while egg laying site.
- The developing larva of wasp was nourished by developing seeds of fig.

13. Lichen is considered as a good example of obligate mutualism. Explain.

- Lichen is a mutual association of an alga and a fungus.
- It is an interaction between two species of organisms in which both are benefitted from the obligate association.
- Algae performs photosynthesis and provide food to fungi and fungi helps algae to absorb water and minerals.

14. What is mutualism? Mention any two examples where the organisms involved are commercially exploited in modern agriculture.

- It is an interaction between two species of organisms in which both are benefitted from the obligate association.
- The cyanobacterium Anabaena is found in the leaves of the water fern Azolla.
- Micorrihiza are formed by symbiotic association with roots of Angiosperms.

15. List any two adaptive features evolved in parasites enabling them to live successfully on their host?

- The parasitic plants Produce houstorial roots to absorb nutrients from the vascular tissues of host plants.
- The parasite gets flower inducing hormone from its host plant Eg : Cuscuta

16. Mention any two significant roles of predation plays in nature.

- Many defense mechanisms are evolved to avoid their predations by plants
- Calotropis produces highly poisonous cardiac glycosides.
- Tobacco produces nicotine.
- Coffee plants produce caffeine.
- Cinchona plant produces quinine.

17. How does an orchid ophrys ensures its pollination by bees?

- The plant Ophrys an orchid, the flower looks like a female insect to attract the male insect to get pollinated by them.
- It is otherwise called 'floral mimicry '.

18. Water is very essential for life. Write any three features for plants which enable them to survive in water scarce environment.

- Stems and leaves are coated with waxy substances.
- Leaves are reduced to spines.
- Presence of multilayered epidermis with thick cuticle to prevent water loss.

19. Why do submerged plants receive weak illumination than exposed floating plants in a lake?

- Floating plants receive direct white light from atmosphere.
- The submerged plants get diffused light.

20. What is vivipary? Name a plant group which exhibits vivipary.

- Seeds germinate in the fruits of mother plant itself are called Vivipary.
- It is exhibited in halophytes.

21. What is thermal stratification? Mention their types.

- The change in the temperature profile with increasing depth in a water body is called thermal stratification.
- The three kinds of thermal stratifications are
  - Epilimnion : The upper layer of warmer water.
  - Metalimnion : The middle layer with a zone of gradual decrease in temperature.
  - Hypolimnion : The bottom layer of colder water.

22. How is rhytidome act as the structural defence by plants against fire?

- Rhytidome is the structural defense by plants against fire.
- It is composed of multiple layers of suberized periderm, cortical and phloem tissues.
- It protects the stem against fire , water loss, invasion of insects and prevents infections by microorganisms.

23. What is myrmecophily?

- Sometimes, ants take their shelter on some trees such as Mango, Litchi, Jamun, Acacia etc.
- These ants act as body guards of the plants against any disturbing agent. the plants in turn provide food and shelter to these ants. this phenomenon is known as myrmecophily.
- Ex : Acacia and acacia ants.

24. What is seed ball?

- Seed ball is an ancient Japanese technique.
- Encasing seeds in a mixture of clay and soil humus (also in cow dung).
- This method is suitable for barren and degraded lands for tree regeneration.

25. How is anemochory differ from zoochory?

Anemochory	Zoochory
The dispersal fruits and seeds by wind	The dispersal fruits and seeds by Birds, animals and human.
Seeds are minute, have wings, feathery appendages etc.. for wind dispersal.	Seeds and fruit surface may have hooks, sticky hairs etc.. for dispersal

26. What is co evolution?

- The interaction between organisms, when continues for generations, involves reciprocal changes in genetic and morphological characters of both organisms.
- This type of evolution is called Co-evolution.
- Eg : Corolla length and proboscis length of butterflies and moths.

27. Explain Raunkiaer classification in the world's vegetation based on the temperature.

- Raunkiaer classification in the world's vegetation based on the temperature are four types.
  - Megatherms
  - Mesotherms
  - Microtherms
  - Hekistotherms.
- Based on the range of thermal tolerance, organisms are divided into eurythermals and stenothermals.

Eurythermal

- Organisms which can tolerate a wide range of temperature fluctuations.
- Example : Zostera

Stenothermal

- Organisms which can tolerate only small range of temperature variations.
- Example : Mango
- Mango plant does not grow in temperate countries like Canada and Germany.

28. List out the effects of fire to plants.

- Fire has a direct lethal effect on plants
- Burning scars are the suitable places for the entry of parasitic fungi and insects.
- It brings out the alteration of light, rainfall, nutrient cycle, fertility of soil, pH, soil flora and fauna
- Some fungi which grow in soil of burnt areas called pyrophilous.
- Example: Pyronema confluens.

29. What is soil profile? Explain the characters of different soil horizons.

- Soil is commonly stratified into horizons at different depth. These layers differ in their physical, chemical and biological properties.
- This succession of super-imposed horizons is called soil profile.

	Horizon	Description
1.	O–Horizon (Organic horizon – Humus)	It consists of fresh or partially decomposed organic matter. O1 – Freshly fallen leaves, twigs, flowers and fruits O2 – Dead plants, animals and their excreta decomposed by micro-organisms. Usually absent in agricultural and deserts.
2.	A–Horizon (Leached horizon)	It consists of top soil with humus, living creatures and in-organic minerals. A1 – Dark and rich in organic matter. A2 – Light coloured layer, rich in mineral particles.
3.	B-Horizon (Accumulation horizon)	It consists of iron, aluminium and silica rich clay organic compounds.
4.	C - Horizon (Partially weathered horizon)	It consists of parent materials of soil, composed of little amount of organic matters without life forms.
5.	R – Horizon (Parent material Bed rock	It is a parent bed rock upon which underground water is found.

30. Give an account of various types of parasitism with examples.

- Parasitism is an interaction between two different species in which the smaller partner (parasite) obtains food from the larger partner (host).
- So the parasitic species is benefited while the host species is harmed.
- Prasitism is classified into two types. They are holoparasite and hemiparasite.

Holoparasites

- The organisms which are dependent upon the host plants for their entire nutrition are called Holoparasites. They are also called total parasites.

Eg :

- Cuscuta is a total stem parasite of the host plant Acacia.

Hemiparasites

- The organisms which derive only water and minerals from their host plant.
- The organisms synthesizing their own food by photosynthesis are called Hemiparasites.
- They are also called partial parasites.

Eg :

- Viscum and Loranthus are partial stem parasites.

31. Explain different types of hydrophytes with examples.

Free floating hydrophytes

- These plants float freely on the surface of water.
- They remain in contact with water and air, but not with soil.
- Ex : Eichhornia, Pistia

Rooted floating hydrophytes

- In these plants, the roots are fixed in mud, but their leaves and flowers are floating on the surface of water.
- These plants are in contact with soil, water and air.
- Ex : Nelumbo, Nymphaea.

Submerged floating hydrophytes

- These plants are completely submerged in water and not in contact with soil and air.
- Ex : Ceratophyllum and Utricularia.

Rooted- submerged hydrophytes

- These plants are completely submerged in water and rooted in soil and not in contact with air.
- Ex : Hydrilla, Vallisneria and Isoetes.

Amphibious hydrophytes

- These plants are adapted to both aquatic and terrestrial modes of life.
- They grow in shallow water.
- Ex: Ranunculus, Typha.

32. Enumerate the anatomical adaptations of xerophytes.

- Presen ce of multilayered epidermis with heavy cuticle to prevent water loss due to transpiration.
- Hypodermis is well developed with sclerenchymatous tissues.
- Sunken stomata are present only in the lower epidermis.
- Scotoactive type of stomata found in succulent plants.
- Mesophyll is well differentiated into palisade and spongy parenchyma.
- In succulents, the stem has water storage region.

33. List out any five morphological adaptations of halophytes.

- The temperate halophytes are herbaceous but the tropical halophytes are mostly bushy.
- In addition to the normal roots, many stilt roots are developed.
- A special type of negatively geotropic roots called pneumatophores with pneumathodes to get sufficient aeration are also present. They are called breathing roots. Ex : Avicennia
- Presence of thick cuticle on the aerial parts of the plant body
- Leaves are thick, entire, succulent and glossy. Some species are aphyllous (without leaves).
- Vivipary mode of seed germination is found in halophytes.

34. What are the advantages of seed dispersal?

- Seeds escape from mortality near the parent plants due to predation by animals and getting diseases and also avoiding competition.
- Dispersal also gives a chance to occupy favourable sites for growth.

- This is the only method available for self fertilized flowers and maternally transmitted genes in out crossing plants.
- Seed dispersal by animals help in conservation of many species even in human altered ecosystems.
- It acts as a key for proper functioning and establishment of many ecosystems from deserts to evergreen forests
- The maintenance of biodiversity conservation and restoration of ecosystems.

35. Describe dispersal of fruit and seeds by animals.

- Birds and mammals, including human beings play an efficient and important role in the dispersal of fruit and seeds.
- The surface of the fruit or seeds have hooks, barbs, spines by means of which they adhere to the body of animals or clothes of human beings and get dispersed.
- Some fruits have sticky glandular hairs by which they adhere to the fur of grazing animals. Ex : Boerhaavia
- Some fruits have viscid layer which adhere to the beak of the bird which eat them and when they rub them on to the branch of the tree, they disperse and germinate. Ex : Cordia
- Some fleshy fruits with conspicuous colours are dispersed by human beings to distant places after consumption.

Additional Questions

36. What is acid rain? mention its effects.

- The sulphur compounds present in atmosphere are responsible for acid rain.

Effects

- Destroys the ozone layer
- Destroys the plants chlorophyll.

37. Which of the plants are called indicators of fire?

- Pteris (fern) and Pyronema (fungus) indicates the burnt up and fire disturbed areas. So they are called indicators of fire.

38. Define: Pedology and Pedogenesis.

- **Pedology :** The study of soil is called pedology.
- **Pedogenesis :** The formation of soil is called pedogenesis.

39. Define: Hollard, Chresard, Echard.

- Hollard : Total soil water content.
- Chresard : Water available to plants.
- Echard : Water not available to plants.

40. What are called as Epiphytes ?

- The plants which are found growing on other plants without harming them are called epiphytes.
- Ex : Vanda.

41. What is called as Velamen tissue ?

- The epiphytic plants contain two types of roots
  - Clinging roots, Aerial roots.
- The aerial roots contain special type of spongy tissue called Velamen.
- It absorbs moisture from the atmosphere air. Eg : vanda.

42. Define phylloclades and give an example.

- All the internodes in the stem are modified into a fleshy leaf structure called phylloclades.
- Ex : Opuntia.

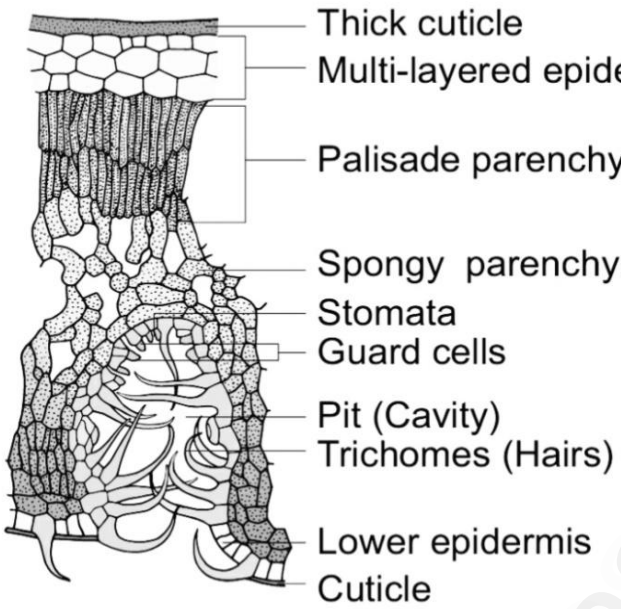
43. What is Cladode ?

- In some xerophytes single or two internodes modified into fleshy green structure called cladode.
- Ex : Asparagus.

44. What is called Phyllode?

- In some xerophytes the petiole is modified into a fleshy leaf like structure called phyllode.
- Ex : Acacia.

45. Draw diagram of an T.S. of Nerium leaf and label the parts.



46. Descibe timber line / Tree line.

- Timber line is an imaginary line in a mountain.
- It marks the level above the trees do not grow.
- The altitudinal limit of normal tree growth is about 3000 to 4000m.

47. Describe negative interactions

- One of the interacting species is benefitted and the other is harmed, it is called negative interaction.
- Ex : predation, parasitism.

48. What is called predation?

- It is an interaction between two species, one of which captures, kills and eats up the other.
- The species which kills is called a predator and the species which is killed is called a prey.
- The predator is benefitted while the prey is harmed.
- Eg : Nepanthes, Drosera.

49. Why Drosera and Nepenthus plants consume insects?

- These plants can produce carbohydrates but not protein. This is due to nitrogen deficiency.
- These plants consume insects for their food for a source of nitrogen.

50. What is Competition? List out their types.

- Competition is an interaction between two organisms or species in which either the organisms or species are harmed.
- Competition is classified into two types
- Intraspecific competition
- Interspecific competition.

51. Explain amensalism / antibiosis with suitable examples.

- It is an interspecific interaction in which one species is inhibited while the other species is neither benefitted nor harmed.
- The inhibition is achieved by the secretion of certain chemicals called allelopathic substances. Amensalism is also called antibiosis.
- Penicillium notatum produces penicillin to inhibit the growth of Staphylococcus bacteria.

52. What is meant by tropophytes ?

- Tropophytes plants which behave as xerophytes at summer and behave as mesophytes (or) hydrophytes during rainy season are called tropophytes.

53. Write the morphological adaptations of epiphytes

- The plants which are found growing on other plants without harming them are called epiphytes.
- Ex : Vanda.

Morphological adaptations

- Root system is extensively developed.
- The epiphytic plants contain two types of roots
  - Clinging roots,
  - Aerial roots.
- Clinging roots fix the epiphytes firmly on the surface of the supporting objects.
- The aerial roots contain special type of spongy tissue called Velamen.
- It absorbs moisture from the atmosphere air.
- Stem of some epiphytes are succulent and develop pseudo bulb or tuber.
- Generally the leaves are lesser in number and may be fleshy and leathery.
- The fruits and seeds are very small.
- Fruits and seeds usually dispersed by wind, insects and birds.

Anatomical adaptations

- Multilayered epidermis is present.
- Inner to the velamen tissue, the peculiar exodermis layer is present.
- Presence of thick cuticle and sunken stomata greatly reduces transpiration.

54. Tabulate the biological interaction of biotic factor.

1. Positive interaction

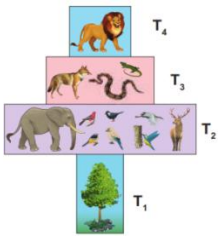
S.NO	Interaction type	Combination		Effects	Examples
1	**Mutualism**	(+)	(+)	Both species benefitted	Lichen, Mycorrhiza etc.
2.	**Commensalism**	(+)	(0)	One species is benefitted and the other species is neither benefitted nor harmed.	orchids, Lianas etc.

2. Negative interaction

S. NO	Interaction type	Combination		Effects	Examples
3.	**Predation**	(+)	(-)	One species benefitted, the other species are harmed.	Drosera, Nepenthes etc.
4.	**Parasitism**	(+)	(-)	One species benefitted, the other species are harmed.	Cuscuta, Duranta, Viscum etc.
5	**Competition**	(-)	(-)	Harmful for both	Grassland species
6.	**Amensalism**	(-)	(0)	Harmful for one, but the other species are Unaffected	Penicillium and Staphylococcus

Lesson – 7 Ecosystem

1. Which of the following is not abiotic component of the ecosystem?
   a) Bacteria b) Humus
   c) Organic compounds d) Inorganic compounds
2. Which of the following is / are not a natural ecosystem?
   a) Forest ecosystem b) Rice field
   c) Grassland ecosystem d) Desert ecosystem
3. Pond is a type of
   a) forest ecosystem b) grassland ecosystem
   c) marine ecosystem d) fresh water ecosystem
4. Pond ecosystem is
   a) not self sufficient and self regulating
   b) partially self sufficient and self regulating
   c) self sufficient and not self regulating
   d) self sufficient and self regulating
5. Profundal zone is predominated by heterotrophs in a pond ecosystem, because of
   a) with effective light penetration b) no effective light penetration
   c) complete absence of light d) a and b
6. Solar energy used by green plants for photosynthesis is only
   a) 2 – 8% b) 2 – 10% c) 3 – 10% d) 2 – 9%
7. Which of the following ecosystem has the highest primary productivity?
   a) Pond ecosystem b) Lake ecosystem
   c) Grassland ecosystem d) Forest ecosystem
8. Ecosystem consists of
   a) decomposers b) producers
   c) consumers d) all of the above
9. Which one is in descending order of a food chain
   a) Producers → Secondary consumers → Primary consumers → Tertiary consumers
   b) Tertiary consumers → Primary consumers → Secondary consumers → Producers
   c) Tertiary consumers → Secondary consumers → Primary consumers → Producers
   d) Tertiary consumers → Producers → Primary consumers → Secondary consumers
10. Significance of food web is / are
    a) it does not maintain stability in nature b) it shows patterns of energy transfer
    c) it explains species interaction d) b and c
11. The following diagram represents
    a) pyramid of number in a grassland ecosystem
    b) pyramid of number in a pond ecosystem
    c) pyramid of number in a forest ecosystem
    d) pyramid of biomass in a pond ecosystem



12. Which of the following is / are not the mechanism of decomposition
    a) Eluviation b) Catabolism c) Anabolism d) Fragmentation
13. Which of the following is not a sedimentary cycle
    a) Nitrogen cycle b) Phosphorous cycle
    c) Sulphur cycle d) Calcium cycle
14. Which of the following are not regulating services of ecosystem services
    i) Genetic resources ii) Recreation and aesthetic values
    iii) Invasion resistance iv) Climatic regulation
    a) i and iii b) ii and iv c) i and ii d) i and iv

2, 3, 5 Marks Questions

1. The productivity of profundal zone will be low. Why?

- The deeper region of a pond is called profundal zone.
- The productivity of profundal zone will be low because of less penetration of light.

2. Discuss the gross primary productivity is more efficient than net primary productivity.

Gross primary productivity (GGP)

- The total amount of organic matter produced in an ecosystem by photosynthesis is called **gross primary productivity.**

Net primary productivity(NPP)

- The proportion of energy which remains after respiration loss in the plant is called net primary productivity.
- Thus the difference between GPP and respiration is known as NPP.
- NPP = GPP - Respiration
- So the GPP is more efficient than NPP.

3. Pyramid of energy is always upright. Give reasons

- The bottom of the pyramid of energy is occupied by the producers.
- There is a gradual decrease in energy transfer at successive tropic levels from producers to the upper levels. Therefore, the pyramid of energy is always upright.

4. What will happen if all producers are removed from ecosystem?

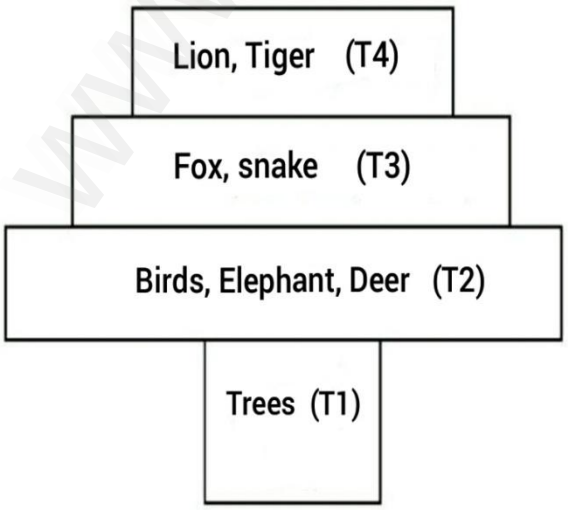
- Producers are the source of food.
- If all producers are removed from the ecosystem, there is no consumers. So the ecosystem is imbalance.
- All other trophic level is affected by not getting food.

5. Construct the food chain with the following data.
(Hawk, plants, frog, snake, grasshopper)

- Plants → grasshopper → frog→ snake →Hawk.

6. Shape of pyramid in a particular ecosystem is always different in shape. Explain with example.

- In a forest ecosystem the pyramid of number is somewhat different in shape.
- The base (T1) of the pyramid occupies large sized trees (producer) which are lesser in number.
- Herbivores (T2) (Fruit eating birds, elephant, deer) occupying second trophic level, are more in number.
- In final trophic level (T4), tertiary consumers (lion) are lesser in number than the secondary consumer (T3) fox and snake.
- Therefore, the pyramid of number in forest ecosystem looks spindle shaped.



7. Name of the food chain which is generally present in all type of ecosystem. Explain and write their significance.

- Detritus food chain is present in all ecosystems.
- Energy is transferred from dead organic matter to series of organisms called detritus food chain.

Significance

- Dead organic matter of plant and animals is broken down by decomposer and then carnivores.
- They help to recycle nutrients in the ecosystem.

8. Generally human activities are against to the ecosystem, where as you a student how will you help to protect ecosystem?

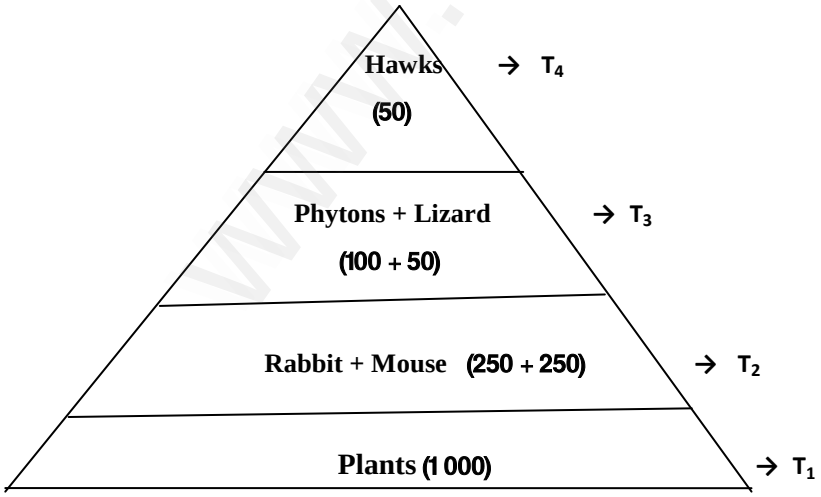
- Buy and use only eco-friendly products and recycle them.
- By growing more trees
- Choose sustained farm products (vegetables, fruits, greens, etc.)
- Reduce the use of natural resources.
- Recycle the waste and reduce the amount of waste you produce.
- Reduce consumption of water and electricity.
- Reduce or eliminate the use of house-hold chemicals and pesticides.
- Maintain your cars and vehicles properly.

9. Generally in summer the forest are affected by natural fire. Over a period of time it recovers itself by the process of successions. Find out the types of succession and explain.

- This types of succession is secondary succession
- The development of a plant community in an area where an already developed community has been destroyed by fire is known as secondary succession.
- Generally, This succession takes less time than the time taken for primary succession.
- Ex **:** The forest destroyed by fire and excessive lumbering may be re-occupied by herbs over period of times.

10. Draw a pyramid from following details and explain in brief. Quantities of organisms are given- Hawks-50, plants-1000.rabbit and mouse-250 +250, pythons and lizard- 100 + 50 respectively.

- The number of producers is maximum - (1000)
- Primary consumers – 500
- Secondary consumers – 150
- Tertiary consumers – 50
- Therefore there is a gradual decrease in the number of organisms in each trophic level from producers to tertiary consumers. Therefore the pyramid of number in grassland ecosystem is upright.



11. Various stages of succession are given bellow. From that rearrange them accordingly. Find out the type of succession and explain in detail. Reed-swamp stage, phytoplankton stage, shrub stage, submerged plant stage, forest stage, submerged free floating stage, marsh medow stage.

Phytoplankton stage

- It consisting of the pioneer community like blue green algae, green algae, diatoms, bacteria.
- The colonization of these organisms enrich the amount of organic matter and nutrients of pond due to their life activities and death.

Submerged plant stage

- As the result of death and decomposition of planktons. Silt brought from land by rain water.
- It leads to a loose mud formation at the bottom of the pond.
- Hence, the rooted submerged hydrophytes begin to appear on the new substratum.
- Ex: Chara, Utricularia, Vallisneria and Hydrilla etc.
- The death and decay of these plants will build up the substratum of pond to become shallow.

Submerged free floating stage

- During this stage, the depth of the pond will become almost 2-5 feet.
- Hence, the rooted hydrophytic plants and with floating large leaves start colonising the pond.
- Ex : Nelumbo, Nymphaea and Trapa.
- By death and decomposition of these plants, further the pond becomes more shallow.

Reed-swamp stage

- It is also known as amphibious stage.
- Plants which can live successfully in aquatic as well as aerial environment.
- Ex : Typha.
- At the end, water level is very much reduced, making it unsuitable for the continuous growth of amphibious plants.

Marsh meadow stage

- The pond becomes swallowed due to decreasing water level. the species of Cyperaceae and Poaceae appear.
- They form a mat-like vegetation with the help of their much branched root system.
- This leads to an absorption and loss of large quantity of water.
- At the end of this stage, the soil becomes dry and the marshy vegetation disappears gradually and leads to shurb stage.

Shrub stage

- Dry soil areas are now invaded by terrestrial plants like shrubs and trees.
- These plants absorb large quantity of water and make the habitat dry.
- Accumulation of humus with a rich flora of microorganisms leads to a next stage.

Forest stage

- It is the climax community of hydrosere.
- A variety of trees invade the area and develop any one of the diverse type of vegetation
- Ex :Temperate mixed forest – Acer
- Tropical rain forest - Cinnamomum
- Tropical deciduous forest - Bamboo and Tectona.

Additional Questions

12. Define : Ecosystem

- The system resulting from the integration of all the living and nonliving factors of the environment'.
- The term Ecosystem was proposed by A.G. Tansley.

13. Differentiate between Lotic and Lentic

Lotic :

- Running water bodies
- Eg : River, stream

Lentic :

- Standing water bodies.
- Eg : Pond, Lake.

14. Define Photosynthetically Active Radiation.

- The amount of light available for photosynthesis of plants is called Photosynthetically Active Radiation (PAR)
- It is between the range of 400-700 nm wave length.

15. What is Food chain?

- The movement of energy from producers upto top carnivores is known as food chain.

16. What is a Food web?

- The inter-locking pattern of a number of food chain form a web like arrangement called food web.

17. Explain types of food chain.

Food chain

- The movement of energy from producers upto top carnivores is known as food chain.

Grazing food chain

- Main source of energy for the grazing food chain is the sun.
- It begins with the first link producers.
- The second link in the food chain is primary consumers (Mouse) which get their food from producers.
- The third link in the food chain is secondary consumers (Snake) which get their food from primary consumers.
- Fourth link in the food chain is tertiary consumers (Eagle) which get their food from secondary consumers.
- Plants → Mouse → snake →Hawk.

detritus food chain

- This type of food chain begins with dead organic matter.
- A large amount of organic matter is derived from the dead plants, animals and their excreta
- The transfer of energy from the dead organic matter, is transferred through a series of organisms called detritus food chain.
- Detritus food chain type is present in all ecosystems.

18. What is homeostasis?

- The inter locking pattern of a number of food chain from a web like arrangement called food web.
- It is the basic unit of an ecosystem, to maintain its stability in nature. Which it's also called homeostasis.

19. Describe energy flow.

- The transfer of energy in an ecosystem between trophic levels are called energy flow.
- Ex : Plants → grasshopper → frog→ snake →Hawk.

20. Why is Pyramid of number in Parasite ecosystems always inverted?

- The pyramid of number in a parasite ecosystem is always inverted, because it starts with a single tree.
- Therefore there is gradual increase in the number of organisms in successive tropic levels from producer to tertiary consumers.

21. What is meant by Ten percent law?

- This law was proposed by Lindeman.
- It states that during transfer of food energy from one trophic level to other, only about 10% is stored at every level and rest of them (90%) is lost in respiration, decomposition and in the form of heat. Hence, the law is called ten percent law.

22. Give an example for first law of thermodynamics.

- Energy can be transmitted from one system to another in various forms.
- Energy cannot be destroyed or created. As a result, the quantity of energy present in the universe is constant.

23. Describe the second law of thermodynamics

- Energy is transferred from one organism to another in the form of food, Energy transformation cannot be 100% efficient.
- A portion of it is stored as energy in living tissue.
- Ex : Ten percent law.

24. What are decomposers?

- Decomposers are organisms that decompose the dead plants and animals to release organic and inorganic nutrients into the environment which are again reused by plants.
- Ex : Bacteria, Actinomycetes and Fungi.

25. Differences between primary and secondary succession.

Primary succession	Secondary succession
Developing in an barren area.	Developing in disturbed area.
Initiated due to a biological or any other external factors.	Starts due to external factors only.
No soil, while primary succession starts.	It starts where soil covers is already present.
Pioneer species come from outside environment	Pioneer species develop from existing Environment
It takes more time to complete.	It takes comparatively less time to complete.

26. What is called as plant succession ?

- The successive replacement of one type of plant community by the other of the same area / place is known as plant succession.

27. Significance of Plant Succession - List them.

- Succession is a dynamic process.
- An ecologist can access and study the seral stages of a plant community found in a particular area.
- It helps to understand the controlled growth of one or more species in a forest.
- It gives information about the techniques to be used during reforestation and afforestation.
- It helps in the maintenance of pastures.
- It helps to maintain species diversity in an ecosystem.
- Forests and vegetation that we come across all over the world are the result of plant succession.

28. List out the biotic components of ecosysytem.

- Plants
- Animals
- Fungi
- Bacteria.

29. What is meant by fragmentation?

- The breaking down of detritus into smaller particles by detritivores like bacteria, fungi and earthwarm is known as fragmentation.

30. What is meant by Catabolism?

- The decomposers produce some extracellular enzymes in their surroundings to break down complex organic and inorganic compounds in to simpler ones. This is called catabolism.

31. What is meant by Mineralisation?

- Some microbes are involved in the release of inorganic nutrients from the humus of the soil, is called mineralisation.

32. What is meant by Leaching or Eluviation?

- The movement of decomposed, water soluble organic and inorganic compounds from the surface to the lower layer of soil or the carrying away of the same by water is called leaching or eluviation.

33. Mention the steps involved in the process of decomposition.

- Fragmentation
- Catabolism
- Leaching
- Humification
- Mineralisation

34. List out the factors affecting decomposition.

- Temperature
- Soil pH
- Soil moisture
- Oxygen
- Chemical quality of detritus.

35. Define biogeochemical cycles

- Circulation of nutrients within the ecosystem or biosphere is known as biogeochemical cycles and also called as cycling of materials.

36. What is meant by ecosystem resilience ?

- Ecosystem is damaged by disturbances from fire, flood, predation, infection, drought, removing a great amount of biomasss.
- However, ecosystem is endowed with the ability to resist the damage and recover quickly. this ability of ecosystem is called ecosystem resilience.

37. Describe blue carbon ecosystems

- The sea grasses and mangroves of Estuarine and coastal ecosystems are the most efficient in carbon sequestration. Hence, these ecosystems are called as “Blue carbon ecosystems”.

38. Explain the different types of carbon.

Green carbon

- Carbon stored in the biosphere (by the process of photosynthesis).

Grey carbon

- Carbon stored in fossil fuel (coal, oil and biogas deposits in the lithosphere).

Blue carbon

- Carbon stored in the atmosphere and oceans.

Brown carbon

- carbon stored in industrialized forests (wood used in making commercial articles)

Black carbon

- Carbon emitted from gas, diesel engine and coal fired power plants.

39. What are known as 3R ?

- Reduce
- Reuse
- Recycle.

40. What is known as Carbon cycle?

- The circulation of carbon between organisms and environment is known as the carbon cycle.
- Cycling of carbon between organisms and atmosphere is a of two reciprocal processes of photosynthesis and respiration.
- The releasing of carbon in the atmosphere increases due to burning of fossile fules, deforestration, forest fire, volcanic eruption and decomposition of dead organic matters.

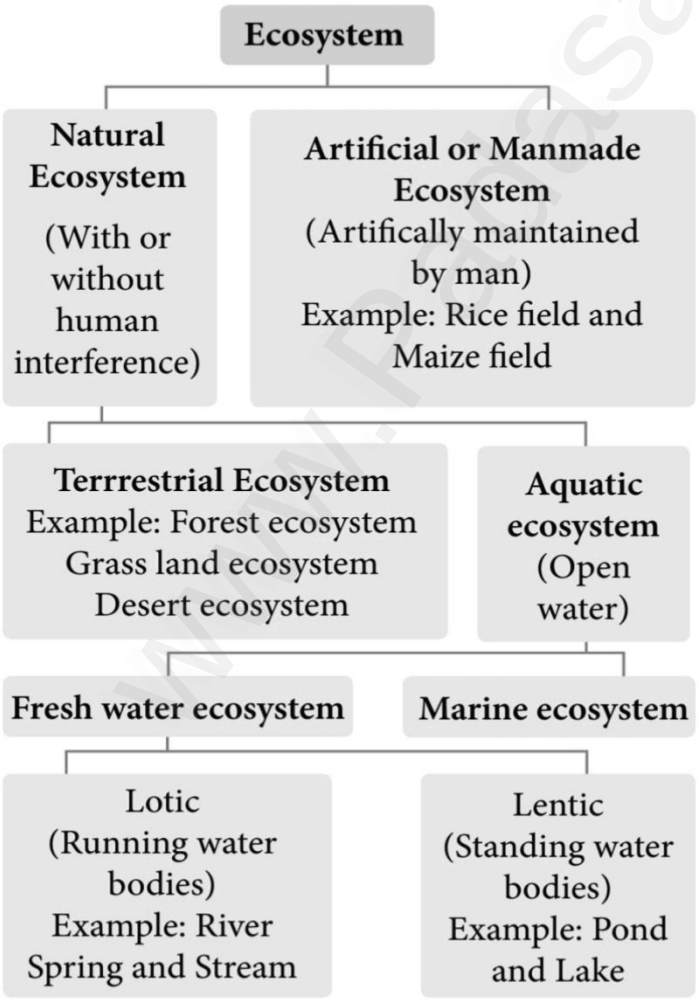
41. Write the significance of food web

- Food web is constructed to describe species interaction called direct interaction.
- It can be used to illustrate indirect interactions among different species.
- It can be used to study bottom- up o top-down control of community structure.
- It can be used to reveal different patterns of energy transfer in terrestrial and aquatic ecosystems.

42. What are the human activities disturb or re-engineer an ecosystem every day?

- The following human activities disturb or re-engineer an ecosystem every day.
- Habitat destruction
- Deforestation and over grazing
- Erosion of soils
- Introduction of non-native species
- Over harvesting of plant material
- Pollution of land, water and air
- Run off pesticides, fertilizers and animal wastes

43. Draw the flow chart of types of ecosystem.



Lesson – 8 Environmental Issues

1. Which of the following would most likely help to slow down the greenhouse effect.
   a) Converting tropical forests into grazing land for cattle.
   b) Ensuring that all excess paper packaging is buried to ashes.
   c) Redesigning landfill dumps to allow methane to be collected.
   d) Promoting the use of private rather than public transport.

2. With respect to Eichhornia
   Statement A : It drains off oxygen from water and is seen growing in standing water.
   Statement B : It is an indigenous species of our country.
   a) Statement A is correct and Statement B is wrong.
   b) Both Statements A and B are correct.
   c) Statement A is correct and Statement B is wrong.
   d) Both statements A and B are wrong.

3. Find the wrongly matched pair.
   a) Endemism - Species confined to a region and not found anywhere else.
   b) Hotspots - Western ghats
   c) Ex-situ Conservation - Zoological parks
   d) Sacred groves - Saintri hills of Rajasthan
   e) Alien sps. Of India - Water hyacinth

4. Depletion of which gas in the atmosphere can lead to an increased incidence of skin cancer?
   a) Ammonia b) Methane c) Nitrous oxide d) Ozone

5. One green house gas contributes 20% of total global warming and another contributes 60%. These are respectively identified as
   a) N_20 and CO_2 b) CFCs and N_20
   c) CH_4 and CO_2 d) CH_4 and CFC_S

6. One of the chief reasons among the following for the depletion in the number of species making endangered is
   a) over hunting and poaching b) green house effect
   c) competition and predation d) habitat destruction

7. Deforestation means
   a) growing plants and trees in an area where there is no forest
   b) growing plants and trees in an area where the forest is removed
   c) growing plants and trees in a pond
   d) removal of plants and trees

8. Deforestation does not lead to
   a) Quick nutrient cycling b) soil erosion
   c) alternation of local weather conditions d) Destruction of natural habitat weather conditions

9. The unit for measuring ozone thickness
   a) Joule b) Kilos c) Dobson d) Watt

10. People's movement for the protection of environment in Sirsi of Karnataka is
    a) Chipko movement b) Amirtha Devi Bishwas movement
    c) Appiko movement d) None of the above

11. The plants which are grown in silivpasture system are
    a) Sesbania and Acacia b) Solenum and Crotalaria
    c) Clitoria and Begonia d) Teak and sandal

2, 3, 5 Marks Questions

1. What is ozone hole?

- The decline in the thickness of the ozone layer over restricted area is called Ozone hole.
- The ozone shield is being damaged by chlorofluorocarbons.

2. Give four examples of plants cultivated in commercial agroforestry.

- Casuarina
- Eucalyptus
- Malai Vembu
- Teak
- Kadambu trees.

3. Expand CCS.

- CCS - Carbon Capture and Storage.
- It is a technology of capturing carbon di oxide.
- CO_2 injects deep into the underground rocks into a depth of 1 km or more.
- It is an approach to reduce global warming.

4. How do forests help in maintaining the climate?

- Forest are a stabilising force for the climate.
- They regulate ecosystems by consuming more Co_2 and reduce global warming.
- Forests increase oxygen production.
- Forests increase rainfall.

5. How do sacred groves help in the conservation of biodiversity?

- Sacred groves are the patches of cultivated trees which are community protected.
- They are based on strong religious belief systems.
- Each grove is an abode of a deity mostly village God Or Goddesses like Aiyanar or Amman
- 448 grooves were documented throughout Tamil Nadu, of which 6 groves (Banagudi shola, Thirukurungudi and Udaiyankudikadu, Sittannnavasal, Puthupet and Devadanam) were taken up for detailed floristic and faunistic studies.
- These groves conserve bio-diversity by protecting watershed, fodder, medicinal plants and micro climate control.

6. Which one gas is most abundant out of the four commonest greenhouse gases? Discuss the effect of this gas on the growth of plants?

- CO_2 (Carbon dioxide) is most abundant greenhouse gases.

Effects

- Low agricultural productivity in tropics.
- Increase of vectors and epidemics.
- Change in flowering seasons and pollinators.
- Water crisis and decreased irrigation
- Change in Species distributional ranges
- Species extinction.

7. Suggest a solution to water crisis and explain its advantages.

- Rain water harvesting is a solution to water crisis.
- Accumulation and storage of rain water for reuse in-site rather than allowing it to run off is called rainwater harvesting.
- Rainwater can be collected from rivers, roof tops and the water collected is directed to a deep pit.
- The water percolates and gets stored in the pit.
- It is an important economical cost effective method for the future.

Environmental advantages of Rain water harvesting

- Promotes adequacy of underground water and water conservation.
- Mitigates the effect of drought.
- Reduces soil erosion as surface run-off is reduced.
- Reduces flood hazards.
- Improves groundwater quality and water table/decreases salinity.

8. Explain afforestation with Case studies.

- The conversion of non-forested lands into forests by planting suitable trees to retrieve the vegetation is called afforestation.
- The Man who Single Handedly Created a Dense Forest.
- Jadav Molai Payeng is an environmental activist. He has single-handedly planted a forest in the middle of a barren wasteland.
- He transformed the world's largest river island, Majuli, located in Brahmaputra river, into a dense forest.
- It has rhinos, deers, elephants, tigers and birds.
- He is called Forest Man of India.

9. What are the effects of deforestation and benefits of agro forestry?

Effects of deforestation

- Burning of forest wood release stored carbon. It is a negative impact just opposite of carbon sequestration.
- It alters water cycle in ecosystem.
- Increases soil erosion and decreases soil fertility.
- Deforestation in dry areas leads to the formation of deserts.
- Increased global warming and account for one third of total CO_2 emission.
- Loss of livelihood for forest dwellers and rural people.
- Loss of life support resources, fuel, medicinal herbs and wild edible fruits.

Benefits of agroforestry

- It is an answer to the problem of soil and water conservation and also stabilise the soil
- Reduce landslide and water run-off problem.
- Nutrient cycling between species improves and organic matter is maintained.
- Trees provide micro climate for crops.
- Maintain $O_2 - CO_2$ balanced, atmospheric temperature and relative humidity.
- Suitable for dry land. (rainfall is minimum) It is a good system for alternate land use pattern.
- Multipurpose trees are used for wood pulp, tanning, paper and firewood industries.
- Ex : Acacia.
- It can be used as farm forestry, mixed forestry, shelter belts and linear strip plantation.

Additional Questions

10. What is called ozone shield? Write their use.

- Ozone layer is a region of earth's stratosphere.
- It acts as a protective shield, cutting the ultraviolet radiation emitted by the sun.

11. What is Dobson Unit ?

- The thickness of the ozone column of the atmosphere is measured in terms of Dobson Units.
- One Dobson unit is the number of molecules of ozone that would be required to create a layer of pure ozone 0.01 millimetre thick at a temperature of $0^{o}C$ and a pressure of 1 atmosphere.

12. List out the effects of Ozone depletion.

- Increases the incidence of cataract, Throat and lung irritation and aggravation of asthma, skin cancer.
- Diminishing the functioning of immune system in human beings.
- Juvenile mortality of animals.
- Increased incidence of mutations.
- Photosynthesis will be inhibited.
- It results global warming and shortage of food leading to food crisis.
- Increase in temperature changes the climate and rainfall pattern.
- Result in flood, drought, sea water rise, imbalance in ecosystems affecting flora and fauna.

13. What are the benefits of ozone shield?

- Ozone layer is a region of earth's stratosphere.
- This layer acts as a shield for absorbing the UV radiations coming from the sun.
- UV radiations are harmful for living organisms causing DNA damage.

14. Write is about Montreal Protocol.

- The international treaty called the Montreal Protocol (1987) was held in Canada.
- Gradually eliminating the production and consumption of ozone depleting substances.

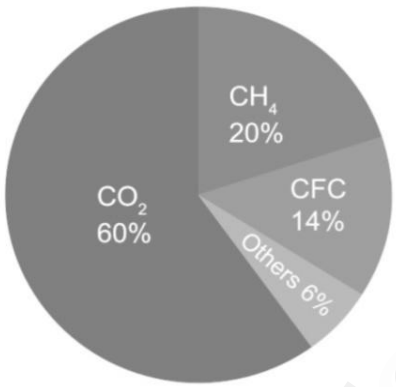
15. What are greenhouse gases ?

- The gases that capture heat are called Green House Gases.
- Eg : CO_2, N_2O, CFC, CH_4.

16. What is meant by greenhouse effect ?

- Radiant heat from the sun is captured by gases in the atmosphere that increase the temperature of the earth ultimately called greenhouse effect.

17. Draw the flow chart of Relative contribution of green house gases



18. Bring out the human activities which lead to produce the greenhouse effect.

- The burning fossil fuels, It releases CO_2 and CH_4
- way of Agriculture and animal husbandry practices
- The chloro fluoro carbons released by refrigerator and air conditioners.
- The fertilizers used in Agriculture which release N_2O.
- The CO_2 emissions from automobiles.

19. What is global warming?

- The increase of global temperature due to increased concentration of greenhouse gases is called global warming.

20. Mention the effects of global warming

- Low agricultural productivity in tropics.
- Drastic change in weather patterns bringing more floods or droughts in some areas.
- Water crisis and decreased irrigation.
- Increase of vectors and epidemics.
- Rising sea cause submergence of many coastal cities in many parts of the world.
- Change in flowering seasons and pollinators.
- Species extinction.

21. Bring out the alternatives to control Global warming.

- Increasing the vegetation cover.
- Grow more trees
- Developing alternate renewable sources of energy
- Minimising uses of nitrogeneous fertilizers, and aerosols.
- Reducing the use of fossil fuels and greenhouse gases.

22. Write about Kyoto protocol.

- Clean Development Mechanism (CDM) is defined in the Kyoto protocol (2007)

Objectives

- To prevent dangerous climate change
- To reduce greenhouse gas emissions.

23. Define agro forestry

- An integration of trees, crops and livestock on the same plot of land are called Agro forestry.

24. What is Social forestry?

- Social forestry refers to the management of forests and afforestation on barren lands with the purpose of helping the environmental, social and rural development and benefits.

25. What is Live fence of fodder trees?

- Various fodder trees and hedges are planted as live fence to protect the property from stray animals.
- **Ex :** Sesbania grandiflora, Erythrina sps, Acacia sps.

26. What is Protein Bank ?

- Various multipurpose trees are planted in and around farm lands and range lands mainly for fodder production.
- **Ex :** Acacia nilotica.

27. Explain about chipko movement ?

- The tribal women of Himalayas protested against the exploitation of forests in 1972.
- Later on it transformed into Chipko Movement by Sundarlal Bahuguna in Mandal village of Chamoli district in 1974.
- People protested by hugging trees together which were felled by a sports goods company.

Main features of Chipko movement

- This movement remained non political
- It was a voluntary movement based on Gandhian thought.
- To give a slogan of five F's – Food, Fodder, Fuel, Fibre and Fertilizer.To make the communities self-sufficient in all their basic needs.

28. Describe appiko movement.

- The famous Chipko Andolen inspired to launch a appiko movement.
- This movement started in Gubbi Gadde a small village near Sirsi in Karnataka by Panduranga Hegde.
- This movement started to protest against felling of trees, monoculture, forest policy and deforestation.

29. What is carbon sink ?

- Any system having the capacity to accumulate more atmospheric carbon during a given time interval than releasing CO_2.
- Ex : forest, soil, ocean.

30. What is Carbon Foot Print ?

- The total amount of greenhouse gases produced by human activities such as agriculture, industries, deforestation, waste disposal, burning fossil fuels directly or indirectly are called carbon foot print.

31. If you imported fruit like kiwi, indirectly it increase carbon foot print. How?

- Kiwi is an imported fruit.
- The fruit has travelled a long distance in shipping or air linear thus emitting tons of CO_2.

32. What is invasive species?

- A non-native species to the ecosystem or country under consideration that spreads naturally, interferes with the biology and existence of native species, poses a serious threat to the ecosystem and causes economic loss.

33. What are the steps taken to reduce carbon foot print ?

- Eating indigenous fruits and products
- Reduce use of your electronic devices
- Reduce travelling
- Do not buy fast and preserved, processed, packed foods.
- Plant a garden
- Less consumption of meat and sea food.
- Reduce use of Laptops
- Line dry your clothes.

34. List out some Alien invasive invasive plants.

- Eichhornia crassipes
- Prosopis juliflora.

35. Describe an invasive weed Eichhornia crassipes.

- It is an invasive weed native to South America.
- It was introduced as aquatic ornamental plant.

Effects

- It affects the growth of phytoplanktons.
- It also decreases the oxygen content of the water bodies and leads to eutrophication.
- poses a threat to human health because it creates a breeding habitat for mosquitoes (Anopheles).
- It also blocks sunlight entering deep and the waterways hampering agriculture, fisheries etc.

36. What are called as plant indicators ? Given some examples.

- The plant species or plant community acts as a measure of environmental conditions, it is referred as plant indicators or phyto indicators.

Plant indicators

- Lichens, Pinus, Rose - SO_2 pollution indicator
- Petunia, Chrysanthemum - Nitrate indicator
- Gladiolus - Flouride pollution indicator
- Robinia pseudoacacia - Indicator of heavy metal contamination.

37. What is Biomonitoring ?

- The observing and assessing the current state and on going changes in ecosystem, biodiversity components, landscape including natural habitats, populations and species are called biomonitoring.

38. What is remote sensing ?

- It is the process of detecting and monitoring the physical characteristics of an area is called Remote Sensing.

39. What is Geographic Information System (GIS) ?

- GIS is a computer system for capturing, storing, checking and displaying data related to positions on Earth's surface.
- It is a constellation of 30 well spaced satellites that orbit the earth.

40. What is Biodiversity Impact Assessment (BIA) ?

- A decision supporting tool to help biodiversity inclusive of development, planning and implementation are called biodiversity impact assessment.

41. Enumerate the uses of biodiversity impact assessment (BIA).

- Change in land use and cover
- Fragmentation and isolation
- Extraction
- External inputs such as emissions, effluents and chemicals
- Introduction of invasive, alien or genetically modified species
- Impact on endemic and threatened flora and fauna.

42. What is endemic species ?

- Endemic species are plants and animals that exist only in one geographic region.

43. Why are we called Jadav "Molai" Payeng as forest man of india ?

- Jadav Molai Payeng is an environmental activist. He has single-handedly planted a forest in the middle of a barren wasteland.
- He transformed the world's largest river island, Majuli, located in Brahmaputra river, into a dense forest.
- It has rhinos, deers, elephants, tigers and birds.
- He is called Forest Man of India.

44. Write the slogan of Chipko movement - (5 F's) ?

- Food
- Fodder
- Fuel
- Fibre
- Fertilizer.

45. Enumerate the causes of deforestation.

- The conversion of forests into agricultural plantation and livestock ranching.
- Logging for timber
- Developmental activities like road construction, electric tower lines and dams.
- Over population, Industrialization, urbanization and increased global needs.

46. Name some satellites and their applications regarding environment.

S.NO	Name of the satellites	Application
1.	SCATSAT - I	Weather forecasting, cyclone prediction and tracking services in india.
2.	INSAT - 3DR	Disaster management
3.	GSAT - 6A	Communication

Lesson – 9 Plant Breeding

1. **Assertion:** Genetic variation provides the raw material for selection
   Reason : Genetic variations are differences in genotypes of the individuals.
   a) Assertion is right and reason is wrong. b) Assertion is wrong and reason is right.
   c) Both reason and assertion is right. d) Both reason and assertion is wrong.
2. While studying the history of domestication of various cultivated plants _____ were recognized earlier
   a) Centres of origin b) Centres of domestication
   c) Centres of hybrid d) Centres of variation
3. Pick out the odd pair.
   a) Mass selection - Morphological characters
   b) Purline selection - Repeated self pollination
   c) Clonal selection - Sexually propagated
   d) Natural selection - Involves nature.
4. Match Column I with Column II

Column I		Column II	
i)	William S. Gaud	I)	Heterosis
ii)	Shull	II)	Mutation breeding
iii)	Cotton mother	III)	Green revolution
iv)	Muller and stadler	IV)	Natural hybridization

(a)	i - I	ii - II	iii – III	iv – IV
(b)	i -III	ii -I	iii –IV	iv –II
(c)	i -IV	ii -II	iii –I	iv-III
(d)	i - II	ii -IV	iii –III	iv –I

5. The quickest method of plant breeding is
   a) Introduction b) Selection
   c) Hybridization d) Mutation breeding
6. Desired improved variety of economically useful crops are raised by
   a) Natural Selection b) Hybridization
   c) Mutation d) Biofertilisers
7. Plants having similar genotypes produced by plant breeding are called
   a) clone b) haploid
   c) autopolyploid d) genome
8. Importing better varieties and plants from outside and acclimatising them to local environment is called
   a) cloning b) heterosis c) selection d) introduction
9. Dwarfing gene of wheat is
   a) pal 1 b) Atomita 1 c) Norin 10 d) pelita 2
10. Crosses between the plants of the same variety are called
    a) interspecific b) inter varietal
    c) intra varietal d) inter generic
11. Progeny obtained as a result of repeat self pollination a cross pollinated crop to called
    a) pure line b) pedigree line
    c) inbreed line d) heterosis
12. Jaya and Ratna are the semi dwarf varieties of
    a) wheat b) rice c) cowpea d) mustard

13.Which one of the following are the species that are crossed to give sugarcane varieties with high sugar, high yield, thick stems and ability to grow in the sugarcane belt of North India?

a) Saccharum robustum and Saccharum officinarum

b) Saccharum barberi and Saccharum officinarum

c) Saccharum sinense and Saccharum officinarum

d) Saccharum barberi and Saccharum robustum

14.Match column I (crop) with column II (Corresponding disease resistant variety) and select the correct option from the given codes.

	Column I		Column II
I)	Cowpea	i)	Himgiri
II)	Wheat	ii)	Pusa Komal
III)	Chilli	iii)	Pusa sadabahar
IV)	Brassica	iv)	Pusa Swarnim

	I	II	III	IV
(a)	Iv	Iii	ii	i
(b)	Ii	I	iii	iv
(c)	Ii	Iv	i	iii
(d)	I	Iii	iv	ii

15.A wheat variety, Atlas 66 which has been used as a donor for improving cultivated wheat, which is rich in

a) iron b) carbohydrates c) proteins d) vitamins

16.Which one of the following crop varieties correct matches with its resistance to a disease?

a) Pusa Komal	Bacterial blight
b) Pusa Sadabahar	White rust
c) Pusa Shubhra	Chilli mosaic virus
d) Brassica	Pusa swarnim

17.Which of the following is incorrectly paired?

a) Wheat - Himgiri

b) Milch breed - Sahiwal

c) Rice - Ratna

d) Pusa Komal - Brassica.

18. Match list I with list II

	List I		List II
i)	Gree Living N_2	a)	Aspergillus sp
ii)	Symbiotic N_2	b)	Amanita sp
iii)	P Solubilizing	c)	Anabaena azollae
iv)	P Mobilizing	d)	Azotobactor

(a)	i – c	ii – a	iii – b	iv – d
(b)	i – d	ii – c	iii – a	iv – b
(c)	i – a	ii – c	iii – b	iv – d
(d)	i – b	ii – a	iii – d	iv – c

2, 3, 5 Marks Questions

1. Differentiate primary introduction from secondary introduction.

Primary introduction	Secondary introduction
When the introduced variety is well adapted to the new environment without any alternation to the original genotype	The introduced variety is subjected to selection to isolate a superior variety and hybridized with a local variety to transfer one or a few characters to them.

2. How are microbial innoculants used to increase the soil fertility?

- Biofertilizers helps crop plants uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil.
- Efficient in fixing nitrogen, solubilising phosphate and decomposing cellulose.
- Designed to improve the soil fertility, and plant growth.
- Biological activity of beneficial microorganisms in the soil.

3. What are the different types of hybridization?

- Intravarietal hybridization
- Intervarietal hybridization
- Interspecific hybridization
- Intergeneric hybridization.

4. Explain the best suited type followed by plant breeders at present?

- Genetic Engineering
- Plant tissue culture
- Protoplasmic fussion
- Molecular marking
- DNA fingerprinting.

5. Write a note on heterosis or Hybrid vigour

- G.H. Shull first used the term heterosis.
- The superiority of the F_1 hybrid in performance over its parents is called heterosis.

6. List out the new breeding techniques involved in developing new traits in plant breeding.

- New breeding techniques (NBT) are a collection of methods that could increase and accelerate the development of new traits in plant breeding.
- Genome editing, to modify DNA at specific base pairs within the plants to produce new traits in crop plants.

Additional Questions

7. Enumerate the objectives of plant breeding

- To increase yield, vigour and fertility of the crop
- To increase tolerance to environmental condition, salinity, temperature and drought.
- To prevent the premature falling of buds, fruits etc.
- To improve synchronous maturity.
- To develop resistance to pathogens and pests.
- To develop photosensitive and thermos sensitive varieties.

8. What is an organic agriculture?

- Organic farming is an alternative agricultural system.
- It is originated early in the twentieth century.
- It is a production system that sustains the health of the soils, ecosystems and people.
- It relies on ecological processes, biodiversity, cycles adapted to local conditions and use of inputs with adverse effects.

9. Define biofertilizers. Write their uses.

- Biofertilizers are defined as preparations containing living cells of efficient strains of microorganisms.
- It helps crop plants uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil.

10. Write the importance of biofertilizers.

- They are efficient in fixing nitrogen, solubilising phosphate and decomposing cellulose.
- Designed to improve the soil fertility, plant growth and biological activity.
- Eco-friendly organic agro inputs.
- More efficient and cost effective than chemical fertilizers.

11. Write note on role of Azolla as biofertiliser.

- Azolla is a free-floating water fern.
- Fixes atmospheric nitrogen in association with nitrogen fixing blue green algae Anabaena azolla.
- It is used as a bio-fertilizer for wetland rice cultivation.
- Increase the yield by 40 – 60 kg/ha/crop.

12. Name some microorganisms used as phosphate mobilizing Bio – fertilizers.

Arbuscular Mycorrhiza

- Glomus, Scutellospora

Ectomycorrhiza

- Amanita.

13. Name some microorganisms used N2 as fixing Bio – fertilizers.

Free-living:

- Azotobacter, Clostridium, Anabaena, Nostoc,

Symbiotic:

- Rhizobium, Anabaena, azollae

Associative Symbiotic

- Azospirillum

14. What is meant by Arbuscular mycorrhizae ?

- Formed by symbiotic association between certain phycomycetous fungus and angiosperm roots.

Significance

- Dissolve phosphates found in soil.
- It provides strength to resist disease,germs and unfavourable weather conditions.
- It also assures water availability.

15. What is meant by bio-pesticides ?

- Bio-pesticides are biologically based agents used for the control of plant pests.

16. Explain the role of Trichoderma for enhancement of plants.

- Trichoderma species are free-living fungus that are common in soil and root ecosystem.

Significance

- Control of plant disease
- Ability to enhance root growth
- Crop production
- Resistance to abiotic stress
- Uptake of nutrients.

17. Explain the role of Beauveria species act as a bio-pesticides.

- Beauveria species is an entomo-pathogenic fungus.
- It grows naturally in soils throughout the world.
- It acts as a parasite on various arthropod species. It causing white muscardine disease without affecting the plant health and growth.
- It also controls damping off of tomato caused by Rhizoctonia solani.

18. Mention the main objectives of green manuring

- To increase the content of nitrogen in the soil.
- It helps in improving the structure and physical properties of the soil.

19. List out some important Crops used as green manures.

- Crotalaria juncea
- Tephrosia purpurea
- Indigofera tinctoria

20. What is Green in-situ manuring ? Give Example.

- Green in-situ manuring refers to the growing of green manuring crops in the border rows or as intercrops along with the main crops.
- Ex : Sun hemp, Cowpea, Green gram.

21. What is Green leaf manuring ? Give example.

- The application of green leaves and twigs of trees, shrubs, plants growing in waste land and field bunds fallen or burried inside the soil convertea as manure.
- Eg : Cassia fistula
- Sesbania grandiflora
- Azadirachata indica
- Pongamia pinnata.

22. What is plant introduction?

- The introduction of genotypes from a place where it is normally grown to a new place or environment are called Plant introduction.
- Rice variety of IR8 introduced from Philippines.
- Wheat varieties of Sonora 63, Sonora 64 from Mexico.

23. Describe Mass selection.

- A large number of plants of similar phenotype or morphological characters are selected and their seeds are mixed together to constitute a new variety.

24. What is Pure line selection ?

- It is a collection of plants obtained as a result of repeated self-pollination from a single homozygous individual.
- Hence, a variety formed by this method shows more homozygosity with respect to all genes.

25. What are the demerits of pure line selection ?

- The new genotypes are never created.
- They are less adaptable and less stable to the environmental fluctuations.

26. Explain Nel Jayaraman contribution to rice

- In 2005, he organized a first ever traditional paddy seed festival in his farm as an individual.
- The 10th seed festival in May 2016 at Adhirangam.
- 156 different traditional varieties were distributed to more than 7000 farmers across Tamil Nadu.
- He gave a talk in Philippines at the International Rice Research Institute (IRRI) on his work and mission.
- In 2011, he received the State Award for best organic farmer. for his contribution to organic farming.
- In 2015, he received the National Award for best Genome Savior.

27. What is meant by polyploids ?

- The plants which possess more than two sets of chromosome are called polyploids

28. Write a note on NORIN 10.

- The cultivars found that Norin 10 dwarfing genes have high photosynthetic rate per unit leaf area and increase respiratory activity.
- Gonjiro Inazuka selected the semi-dwarf wheat variety that became Norin 10.
- Norin 10 helped to save more than one billion lives from hunger and starvation.

29. Mention some semi dwarf wheat breeding varieties.

- Sonora 64
- Sonalika
- Kalyansona

30. Mention any two semi dwarf Breeded Rice varieties in India.

- Jaya
- Ratna

31. Why is Dr. M.S. Swaminathan called as Father of green revolution in India?

- He is pioneer mutation breeder.
- He was produced Sharbati sonara, is the amber grain coloured variety of wheat by mutation. which is responsible for green revolution in India.

32. List out any three important Indian Plant Breeders.

- Dr. M.S.Swaminathan – He is pioneer mutation breeder.
- T.S.Venkataraman – An eminent sugarcane breeder.
- Dr. B.P.Pal – Famous wheat breeder.

33. What is mutation ?

- The sudden heritable changes in the genotype or phenotype of an organism is called mutation.

34. List out the Physical and Chemical Mutagens used in Plant breeding.

Physical Mutagens

- UV short wave, X-ray, Alpha (α), Beta (β), Gamma waves.

Chemical Mutagens

- cesium, EMS (ethyl methane sulfonate), nitromethyl, urea.

35. Describe gamma garden or atomic garden

- The plants are exposed to radioactive sources for mutation breeding called Gamma Garden
- Ex :Cobalt-60 or caesium-137
- The first Gamma garden in India is Bose Research Institute at Calcutta in 1959.
- The second is IARI in 1960 which produced large variation in short type.

36. Wht is parbharni kranti ?

- The resistance to yellow mosaic virus in bhindi (Abelmoschus escullentus) was transferred from a wild species.
- It produces a new variety of A. escullentus called Parbharni kranti.

37. Describe : NBPGR

- NBPGR -National Bureau of plant Genetic Resources
- It is located at Rangpuri, New Delhi.
- It is responsible for introduction and maintenance of germ plasm of various agricultural and horticultural station in our country.
- It is also responsible for maintenance of plant materials of botanical and medicinal interest.

38. Differentiate autopolyploidy from allopolyploidy.

S.NO	Autopolyploidy	Allopolyploidy
1.	The number of chromosome is doubled by itself in the same plant.	The number of chromosome is doubled by crossing over of two different species.
2.	Eg : Sugarbeets, apples	Eg : Triticale

39. What **are the types of Conventional Plant Breeding Methods?**

- Plant Introduction
- Selection
- Hybridization.

40. What is acclimatization?

- The adjustment or adaptation of the introduced plant in the changed environment is called acclimatization**.**

41. What are the steps of Hybridization?

- Steps involved in hybridization are as follows.
- Selection of Parents
- Emasculation
- Bagging
- Crossing
- Harvesting seeds and raising plants.

Selection of Parents

- Male and female plants of the desired characters are selected.
- It should be tested for their homozygosity.

Emasculation

- The removal of anthers to prevent self pollination before anthesis is called emasculation**.**

Bagging

- The stigma of the flower is protected against any undesirable pollen grains, by covering it with a bag.

Crossing

- Transfer of pollen grains from selected male flower to the stigma of the female emasculated flower.

Harvesting seeds and raising plants

- The pollination leads to fertilization and finally seed formation takes place.
- The seeds are grown into new generation which are called hybrid.

Lesson – 10 Economically Useful plants and Entrepreneurial Botany

1. Consider the following statements and choose the right option.
   i) Cereals are members of grass family.
   ii) Most of the food grains come from monocotyledon.
   a) (i) is correct and (ii) is wrong
   b) Both (i) and (ii) are correct
   c) (i) is wrong and (ii) is correct
   d) Both (i) and (ii) are wrong
2. Assertion: Vegetables are important part of healthy eating.
   Reason : Vegetables are succulent structures of plants with pleasant aroma and flavours.
   a) Assertion is correct, Reason is wrong
   b) Assertion is wrong, Reason is correct
   c) Both are correct and reason is the correct explanation for assertion.
   d) Both are correct and reason is not the correct explanation for assertion.
3. Groundnut is native of _____
   a) Philippines b) India c) North America d) Brazil
4. Statement A: Coffee contains caffeine
   Statement B: Drinking coffee enhances cancer
   a) A is correct, B is wrong
   b) A and B – Both are correct
   c) A is wrong, B is correct
   d) A and B – Both are wrong
5. Tectona grandis is coming under family
   a) Lamiaceae
   b) Fabaceae
   c) Dipterocaipaceae
   d) Ebenaceae
6. Tamarindus indica is indigenous to
   a) Tropical African region
   b) South India, Sri Lanka
   c) South America, Greece
   d) India alone
7. New world species of cotton
   a) Gossipium arboretum
   b) G.herbaceum
   c) Both a and b
   d) G.barbadense
8. Assertion : Turmeric fights various kinds of cancer
   Reason : Curcumin is an anti-oxidant present in turmeric
   a) Assertion is correct, Reason is wrong
   b) Assertion is wrong, Reason is correct
   c) Both are correct
   d) Both are wrong
9. Find out the correctly matched pair.
   a) Rubber - Shorea robusta
   b) Dye - Lawsonia inermis
   c) Timber - Cyperus papyrus
   d) Pulp - Hevea brasiliensis
10. Observe the following statements and pick out the right option from the following
    Statement I – Perfumes are manufactured from essential oils.
    Statement II – Essential oils are formed at different parts of the plants.
    a) Statement I is correct
    b) Statement II is correct
    c) Both statements are correct
    d) Both statements are wrong
11. Observe the following statements and pick out the right option from the following:
    Statement I : The drug sources of Siddha include plants, animal parts, ores and minerals.
    Statement II : Minerals are used for preparing drugs with long shelf-life.
    a) Statement I is correct
    b) Statement II is correct
    c) Both statements are correct
    d) Both statements are wrong
12. The active principle trans-tetra hydro canabial is present in
    a) Opium b) Curcuma c) Marijuana d) Andrographis
13. Which one of the following matches is correct?
    a) Palmyra - Native of Brazil
    b) Saccharun - Abundant in Kanyakumari
    c) Steveocide - Natural sweetener
    d) Palmyra sap - Fermented to give ethanol

2, 3, 5 Marks Questions

1. Write the cosmetic uses of Aloe.

- 'Aloin' and its gel are used as skin tonic.
- It has a cooling effect and moisturizing characteristics. So used in preparation of creams, lotions, shampoos and shaving creams.
- It is used in gerontological applications for rejuvenation of aging skin.
- Products prepared from aloe leaves have multiple properties such as emollient, antibacterial, antioxidant, antifungal and antiseptic.
- Aloe vera gel is used in skin care cosmetics.

2. What is pseudo cereal? Give an example.

- Pseudo-cereal is one of any non -grasses that are used in much the same way as cereals.
- Ex : quinoa

3. Discuss which wood is better for making furniture.

- Teak wood is better for making furniture.
- The heartwood is golden yellow to golden brown when freshly sawn, turning darker when exposed to light. Known for its durability as it is immune to the attack of termites and fungi.
- The wood does not split or crack and is a carpenter friendly wood.
- It is also used in making boats, toys, plywood, door frames and doors.

4. A person got irritation while applying chemical dye. What would be your suggestion for alternative?

- My suggestion for alternative is 'Henna' dye.
- 'Henna' is obtained from the leaves and young shoots of Lawsonia inermis.
- The leaves contains 'lacosone" is harmless and causes no irritation to the skin.

5. Name the humors that are responsible for the health of human beings.

- Vatam
- Pittam
- Kapam.

6. Give definitions for organic farming?

- The organic farming is an alternative agricultural system.
- The plants are cultivated in natural ways by using biological inputs to maintain soil fertility and ecological balance thereby minimizing pollution and wastage.

7. **Which is called as the "King of Bitters"? Mention their medicinal importance.**

- Nilavembu (Andrographis paniculata) is known as the King of Bitters.

Medicinal importance

- Andrographis is a potent hepatoprotective and used to treat liver disorders.
- Concoction of Andrographis paniculata and eight other herbs (Nilavembu Kudineer) is effectively used to treat malaria and dengue.

8. Differentiate bio-medicines and botanical medicines.

Biomedicines

- The medicinally useful molecules obtained from plants that are marketed as drugs are called Biomedicines.

Botanical medicines

- Medicinal plants which are marketed as powders or in other modified forms are known as Botanical medicines.

9. Write the origin and area of cultivation of green gram and red gram.

Green gram

- It is a native of India and the archaeological evidences are found in Maharashtra.
- It is cultivated in Madhya Pradesh, Karnataka and Tamil Nadu.

Red gram / pigeon pea

- It is the only pulse native to Southern India.
- It is mainly grown in Maharashtra, Andhra Pradesh, Madhya Pradesh, Karnataka and Gujarat.

10. What are millets? What are its types? Give example for each type.

- It is a variety of very small seeds.
- Originally cultivated by ancient people in Africa and Asia.
- They are gluten free and have less glycemic index.

Millets

Finger Millet

- Ragi - Eleusine coracana
- Sorghum - Sorghum vulgare

Minor Millets

Foxtail Millet

- Thinai - Setaria italic

Kodo Millet

- varagu - Paspalum scrobiculatum.

11. If a person drinks a cup of coffee daily it will help him for his health. Is this correct? If it is correct, list out the benefits.

- Yes, It is correct.

Benefits

- Caffein present in coffee release acetylcholine in brain, which in turn enhances efficiency.
- It can lower the incidence of fatty liver diseases, cirrhosis and cancer.

12. Enumerate the uses of turmeric.

- Turmeric is used as a colouring agent in in pharmacy, confectionery and food industry.
- It is also used for dyeing leather, fibre, paper and toys.
- Curcumin extracted from turmeric is responsible for the yellow colour.
- Curcumin is a very good anti-oxidant which may help fight various kinds of cancer.
- It stops platelets from clotting in arteries, which leads to heart attack.
- It has anti-inflammatory, anti-diabetic, antibacterial, anti-fungal and anti-viral activities.

13. What is TSM? How does it classified and what does it focuses on?

- TSM : Traditional Systems of Medicines.
- India has a rich medicinal heritage.
- TSM in India can be broadly classified into
- 1. institutionalized or documented
- 2. non-institutionalized or oral traditions.

Institutionalized or Documented indian systems

- Institutionalized Indian systems include Siddha and Ayurveda.
- These are practiced for about two thousand years.
- Have prescribed texts describing symptoms, disease diagnosis, drugs to cure, preparation of drugs etc

Non- institutional systems

- This do not have such records
- Practiced by rural and tribal peoples across India.
- The knowledge is mostly held in oral form.

TSM focus on

- TSM focus on healthy lifestyle and healthy diet for maintaining good health and disease reversal.

14. Write the uses of nuts you have studied.

- Cashews are commonly used for garnishing sweets or curries.
- Ground into a paste which forms a base of sauces for curries or some sweets.
- Rted and raw kernels are used as snacks.

15. Give an account on the role of Jasminum in perfuming.

- The essential oil is present in the epidermal cells of both the sepals and petals.

Role of Jasminum in perfuming

- Jasmine flowers are used in India for worship, ceremonial purposes, incense and fumigants,
- It is used for making perfumed hair oils, cosmetics and soaps.
- Jasmine oil is valued for its soothing, relaxing, antidepressant qualities.
- Jasmine blends well with other perfumes.
- It is used in air freshners, anti-perspirants, talcum powders, shampoos and deodorants.

16. Give an account of active principle and medicinal values of any two plants you have studied.

Keezhanelli

Botanical name : Phyllanthus amarus.

Active principle : Phyllanthin is the major chemical component.

Medicinal values

- Used in the treatment of Jaundice.
- Extract is effective against hepatitis B virus.

Nilavembu

Botanical name : Andrographis paniculata.

Active principle : Andrographolides is the major chemical component.

Medicinal values

- Andrographis is a potent hepatoprotective and used to treat liver disorders.
- Concoction of Andrographis paniculata and eight other herbs (Nilavembu Kudineer) is effectively used to treat malaria and dengue.

17. Write the economic importance of rice.

- Rice is the easily digestible calorie rich cereal food.
- Rice is used as a staple food in Southern and North East India.
- Flaked rice (Aval), Puffed rice / parched rice (Pori) are used as breakfast or as snack food.
- Rice bran oil is used in culinary and industrial purposes.
- Husks are used as fuel, and in packing material and fertilizer.

18. Which TSM is widely practiced and culturally accepted in Tamil Nadu? - explain.

- Siddha is widely practiced and culturally accepted system in Tamil Nadu.
- It is based on the texts written by 18 Siddhars.
- The Siddhars are not only from Tamil Nadu, but have also come from other countries.
- The entire knowledge is documented in the form of poems in Tamil.
- It is principally based on the Pancabuta philosophy.
- According to this system three humors namely Vatam, Pittam and Kapam.
- These are responsible for the health of human beings .
- The drug sources of Siddha include plants, animal parts, marine products and minerals.
- This system specializes in using minerals for preparing drugs with the long shelf-life.
- It uses about 800 herbs as source of drugs.
- Great stress is laid on disease prevention, health promotion, rejuvenation and cure.

19. What are psychoactive drugs? Add a note Marijuana and Opium.

- The phytochemicals / drugs from some of the plants alter an individual's perceptions of mind by producing hallucination are known as psychoactive drugs.

Opium

- Botanical name : Papaver somniferum
- It is native to South Eastern Europe and Western Asia.
- Madhya Pradesh, Rajasthan and Uttar Pradesh are the licenced states to cultivate opium poppy.
- It is derived from the exudates of fruits of poppy plants.
- Opium was traditionally used to induce sleep and for relieving pain.
- It yields Morphine, a strong analgesic which is used in surgery.
- However, opium is an addiction forming drug.

Marijuana

- Botanical name **:** Cannabis sativa

Origin : China

- Gujarat, Himachal Pradesh, Uttarkand, Uttarpradesh and Madhaya Pradesh have legally permitted to cultivate Marijuana
- The active principle in marijuana is transtetra hydrocanabinal (THC).
- It is an effective pain reliever and reduces hypertension.
- THC is used in treating Glaucoma a condition in which pressure develops in the eyes.
- THC is also used in reducing nausea of cancer patients undergoing radiation and chemotherapy.
- THC provides relief to bronchial disorders, especially asthma as it dilates bronchial vessels.

20. What are the King and Queen of spices? Explain about them and their uses.

- Pepper is referred to as the "King of Spices".
- Cardamom is called as "Queen of Spices".

Uses of black pepper

- Two types of pepper namely
  - Black pepper
  - White pepper.
- It is used for flavouring in the preparation of sauces, soups, curry powder and pickles.
- It is used in medicine as an aromatic stimulant for enhancing salivary and gastric secretions. and stomachic.
- Pepper also enhances the bio-absorption of medicines.

Uses of cardamom

- The seeds have a pleasing aroma, slightly pungent taste.
- It is used for flavouring confectionaries, bakery products and beverages.
- The seeds are used in the preparation of curry powder, pickles and cakes.
- Medicinally, it as a stimulant and carminative.
- It is also chewed as a mouth freshener.

21. How will you prepare an organic pesticide for your home garden with the vegetables available from your kitchen?

- Mix 120 g of hot chillies with 110 g of garlic or onion. Chop them thoroughly.
- Blend the vegetables together manually or using an grinder till it forms a thick paste.
- Add the vegetable paste to 500 ml of warm water and stir them.
- Pour the solution into a glass container and leave it undisturbed for 24 hours..
- Strain the mixture. This filtrate is the pesticide.
- Either discard the vegetables or use it as a compost.
- Pour the pesticide into a squirt bottle. Make sure that the spray bottle has first been cleaned with warm water and soap to get rid it of any potential contaminants.
- Spray your plants with the pesticide.
- Treat the infected plants every 4 to 5 days with the solution. After 3 or 4 treatments, the pest will be eliminated.

Additional Questions

22. What is called as Vulcanization?

- The rubber articles could be overcome by heating rubber with sulphur under pressure at 150^{o} C.

23. List out the uses of Palmyra.

- Exudate from inflorescence axis is collected for preparing palm sugar.
- Inflorescence is tapped for its sap which is used as health drink.
- Sap is processed to get palm jaggery or fermented to give toddy.
- Endosperm is used as a refreshing summer food.
- Germinated seeds surrounded by fleshy scale leaf which is edible.

24. What is Capsaicin? Write short notes on it.

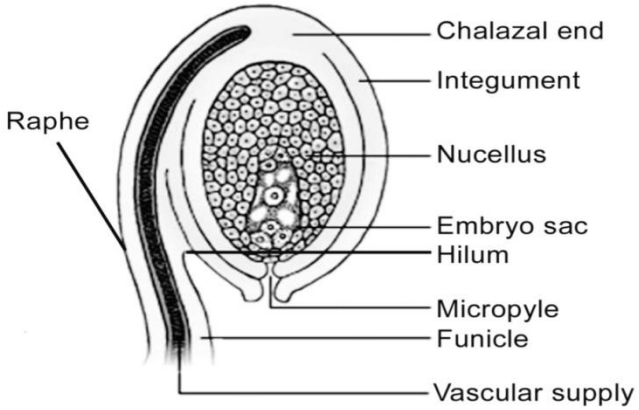
- Capsaicin is responsible for the pungency or spicy taste of chillies.
- Pungency of Chillies is measured in Scoville Heat Units (SHU).
- World's hottest chilli, Carolina reaper pepper measures 2,200,000 SHU.
- Naga viper chilli is the hottest in India that measures 1,349,000 SHU.

25. List out the medicinal uses of any five common medicinal plants.

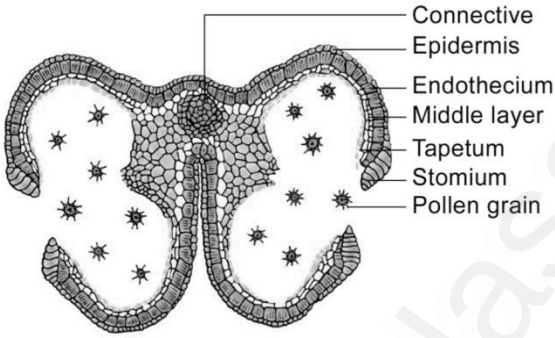
Common Name	Botanical Name	Medicinal uses
Veldt grape	Cissus quadrangularis	Root of this plant used in bone fractures.
Vilvam	Aegle marmelos	To treat problems of stomach indigestion.
Indian Acalypha	Acalypha indica	Used to cure skin diseases.
Indian gooseberry	Phyllanthus emblica	It has a anti-ageing properties.
Holy basil	Ocimum sanctum	To treat anti hypertensive.

Botany - Diagrams

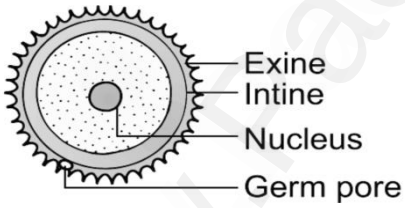
1. Ovule - structure



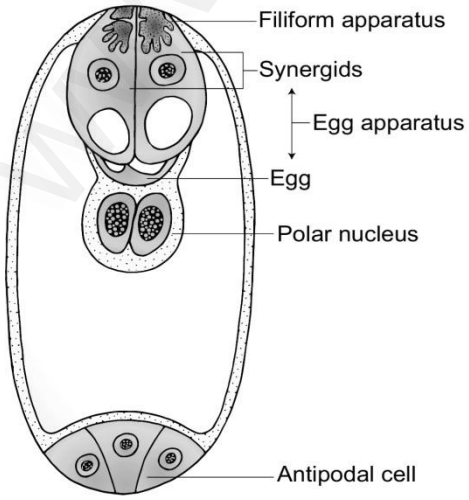
2. T.S. of Mature anther



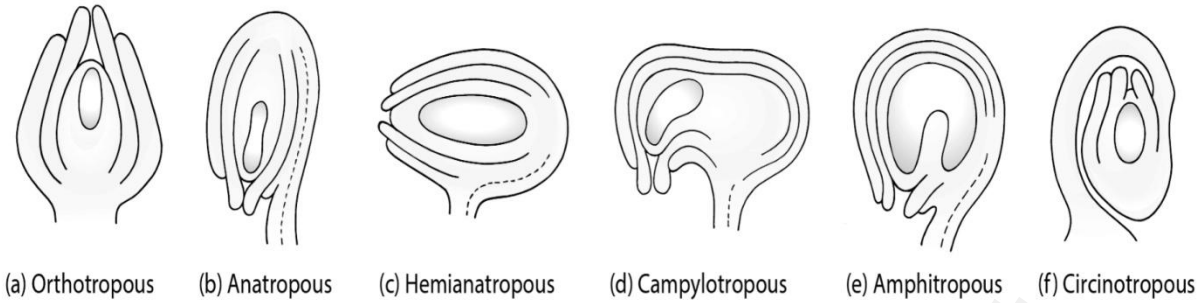
3. Mature pollen grain - Structure



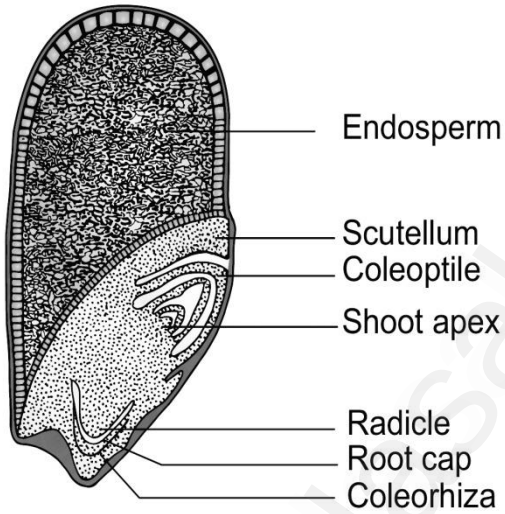
4. Structure of Embryo sac



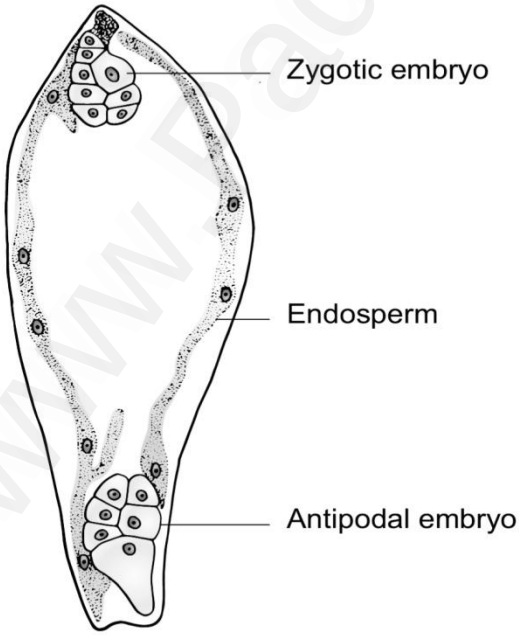
5. Types of ovule



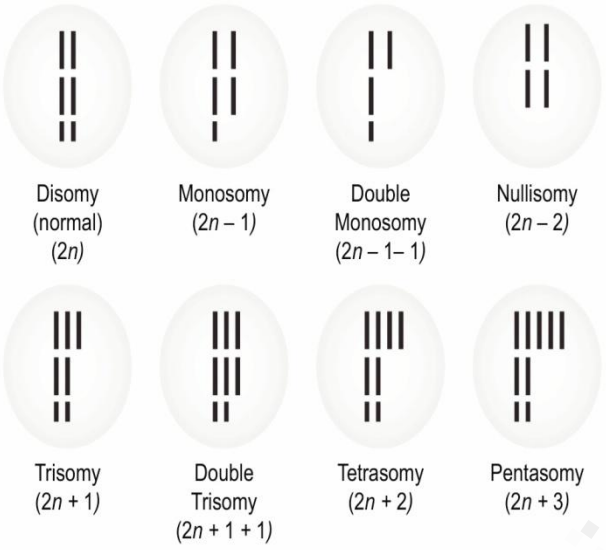
6. Monocot seed



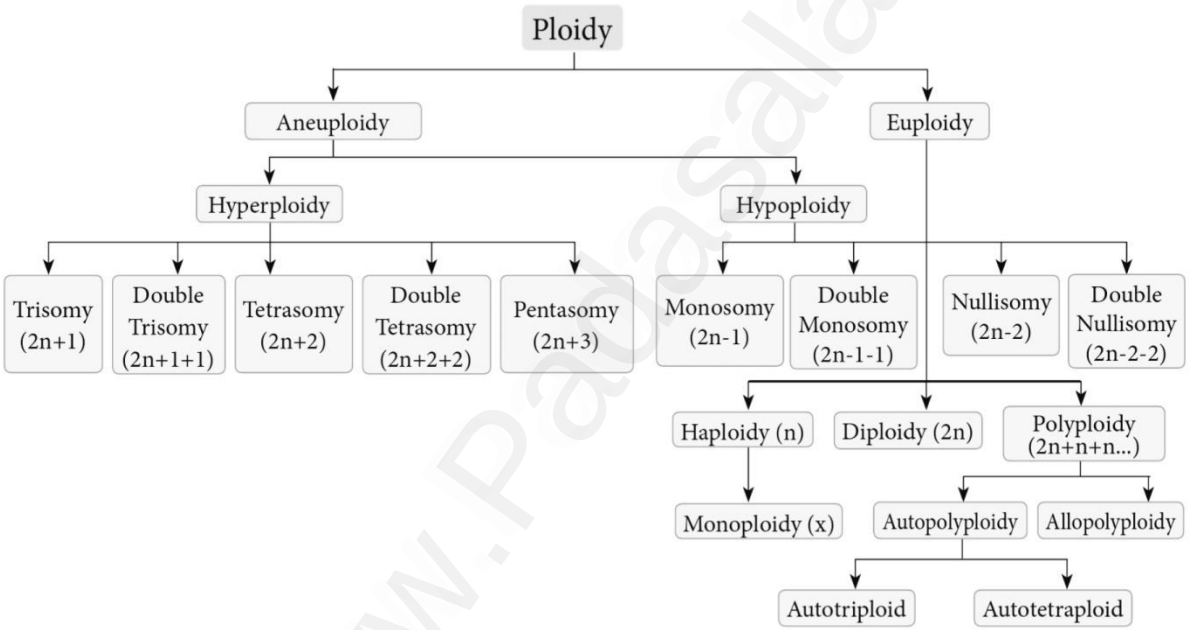
7. Polyembryony – Embryo sac



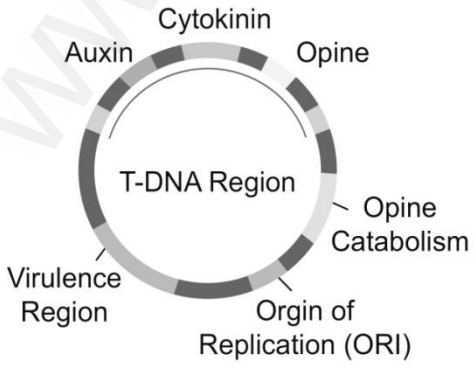
8. Types of aneuploidy



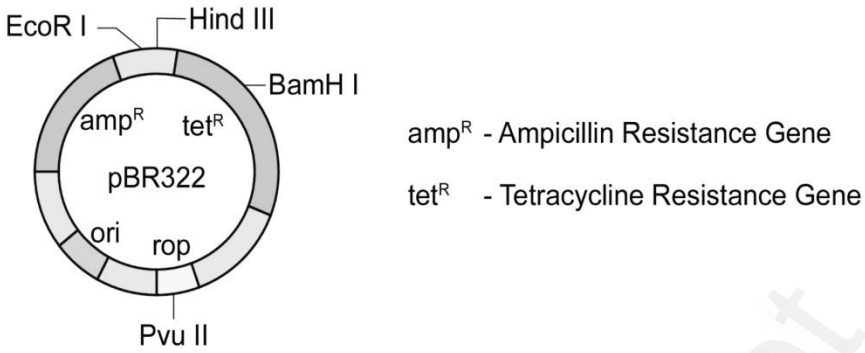
9. Types of ploidy



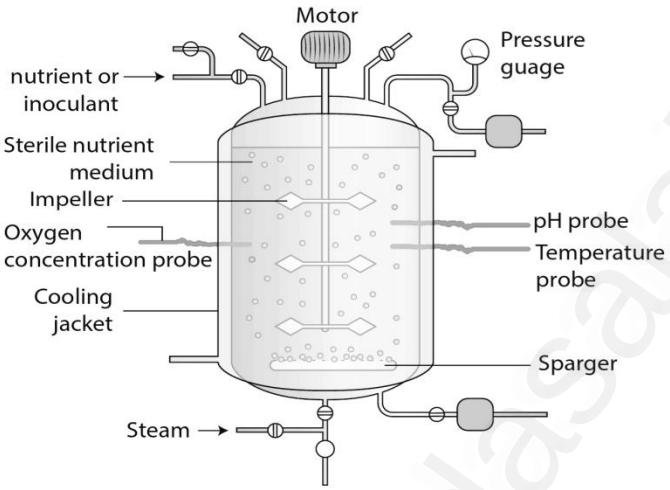
10. Ti - Plasmid



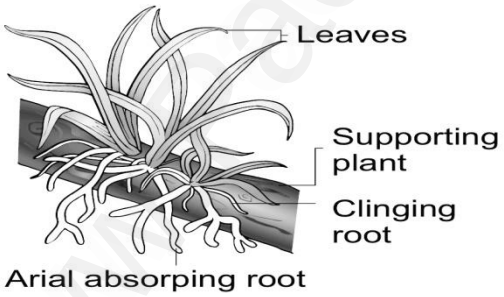
11. pBR 322 – Plasmid



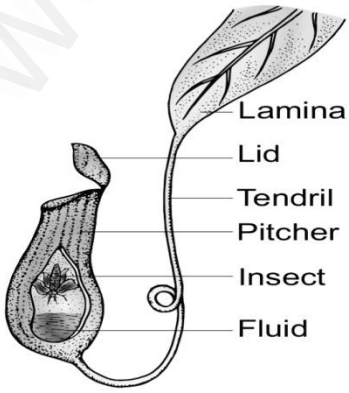
12. Bioreactor



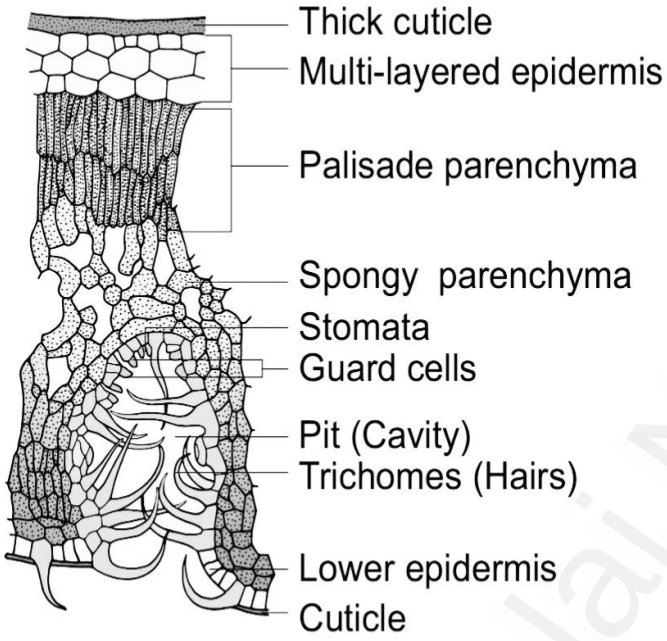
13. Epiphytic plant – Vanda



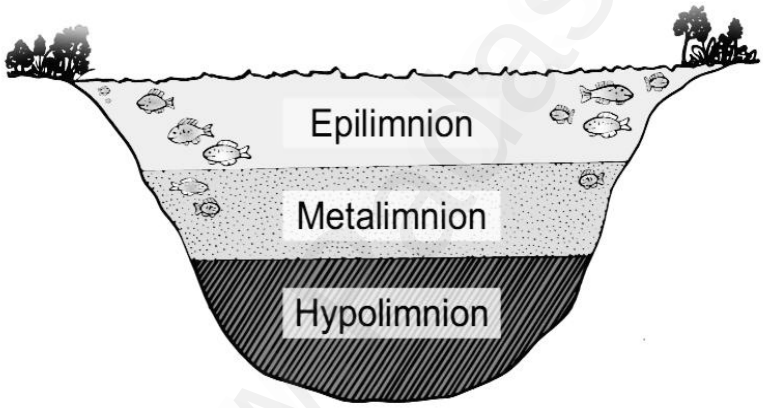
14. Pitcher plant - Nepenthes



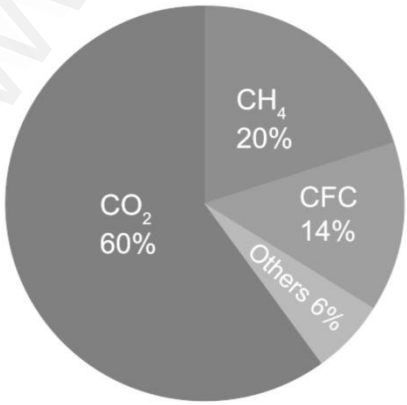
15. T.S. of Nerium leaf



16. Thermal stratification of pond



17. Relative contribution of green house gases



18. Protoplast culture