SYNOPSIS

- Natural forests, botanical gardens, shrub jungles etc., we observe large number of plants exhibiting variability in their size as well as in their vegetative and reproductive morphological characters.
- It is not easy to study, understand and record all such heterogeneous group of plants individually, but yet possible using specific approach. This approach is taxonomy
- The term Taxonomy was coined by **A.P.de Candolle** in 1813
- Taxonomy purely based on the description of morphological characteristics, is called **'Alpha Taxonomy**
- **Omega Taxonomy'** in which information from other sources,viz.,Embryology,Cytology, Palynology, Phytochemistru, Serology etc.
- Taxonomy includes four basic components viz., characterization, identification, nomenclature and classification.

8.1.SYTEM, TYPES OF CLASSIFICATION

- Classification of plants refers to grouping plants based on their structural similarities and inter relationships.
- The earlier classifications of plants were based on their economic uses. e.g. Cereals, medicinal plants, fibre- yielding plants, oil-yielding plants etc., or on gross structural resemblances, e.g., herbs, shrubs, trees,climbers etc.
- different systems or classifications have developed gradually over the period and in tune with the advances that have taken place in other branches of Botany as well as in allied sciences
- Artificial system is the earliest system of plant classification based only on gross superficial morphological characters such as habit, colour, number and shape of leaves etc.
- closely related plants were often placed in different groups, while unrelated plants were placed in the same group because of the presence or absence of a particular character. This system did not indicate the natural relationship that exists among the individuals forming a group. Never theless identification of an unknown plant was rendered easier by this system
- **Theophrastus** (370 to 285 BC) classified plants into 3 groups based on their habit as (i) herbs (ii) shrubs and (iii) trees in his book **'Historia Plantarum'**
- **Linnaeus** (1754) classified plants into 24 groups on the basis of number, length and union of stamens and of carpels (sexual characters) in his book "**Species Plantarum**", these are examples of artificial systems of classification.
- They gave equal importance to vegetative and sexual characteristics. This is not acceptable since we know now that often the vegetative characters are not stable as they get affected more easily by environment.
- In Natural System of classification,all the important, mostly morphological, characters were taken into consideration and plants were classified accordingly
- plants were first classified into few big groups. These were further divided and subdivided into smaller and smaller groups until the smallest division/taxon species) is reached
- the floral characters were given greater importance since they are more conserved and do not change due to the effect of environment.
- Natural System still provides an easy means of the identification of plants.
- **Bentham & Hooker**'s (1862-1893) system of classification of plants as proposed in their book "Genera Plantarum" is a Natural System of Classification)
- Bentham and Hooker divided the flowering plants into three classes namely Dicotyledonae, Gymnospermae and Monocotyledonae
- Gamopetalae was divided into three series viz. Inferae (with 3 cohorts), Heteromerae (with 3 cohorts) and Bicarpellatae (with 4 cohorts)
- Monochlamydae was divided into eight series (not divided into cohorts)
- The flowering plants into 202 natural orders now called as families) (Of these 165 natural orders belong to Dicotyledonae
- The classifications of post-Darwinian period considered evolutionary trends in plants and so they

are considered as phylogenetic systems) In a phylogenetic system, primitive and advanced characters are recognized.) 'Evolution may be progressive or retrogressive

- The status of a taxon, a comprehensive picture of all the characters is taken in to account
- The system proposed by Engler and Prantl in their book "**Die Naturlichen Planzenfamilien**
- J.Hutchinson (1954) in his book "**Families of Flowering Plants**" are examples for phylogenetic system
- The latest phylogenetic classfication is **APG Angiospermic Phylogenetic Group)** system

OTHER TYPES

Numerical Taxonomy

- Mathematical methods to evaluate observable differences and similarities between taxonomic groups
- This process, number and codes are assigned to all the characters and the data are then processed. Each character is given equal importance and at the same time hundreds of characters can be considered

Cytotaxonomy

- Branch of taxonomy that uses the cytological characters like ,chromosome number,structure in solving taxonomic problems

Chemotaxonomy

- branch of taxonomy that uses the phytochemical data to solve the problems of taxonomy.

8.2.Semi Technical Discription of a Typical Flowering Plant

- The plant is described beginning with its habit, habitat, vegetative characters (roots,stem and leaves) and then floral characters(inflorescence, flower and its parts) followed by fruit
- The floral formula is represented by some symbols of floral parts
- Br stands for bracteate, Ebr for ebracteate
- ♂ for male, ♀ for female, ⚥ for bisexual flower
- K stands for calyx, C for corolla, P for perianth, A for androecium and G for Gynoeciuim.
- $\underline{G}$ stands for superior ovary and a $\overline{A}$ for inferior ovary $\overline{G}$
- Floral formula corresponding whorl as subscript of the respective symbol
- It also shows cohesion (union among similar members) and adhesion (union be teen dissimilar members
- A floral diagram provides information about the number of parts of a flower their arrangement and the relation they have with one another (Figure 8.1). The mother axis represents the posterior side of the flower and is indicated as a dot or a circle at the top of the floral diagram
- Calyx, corolla, androecium and gynoecium are drawn in successive whorls, calyx being the outer most and the gynoecium being it the centre represented by a diagram of T.S. of ovary
- The bract represents the anterion side of(the flower and is indicated at the bottom of the floral diagram. The floral: diagram and floral formula shown in Figure 8.1 represent those of the mustard plant (Family: Brassicaceae)

8.3.Description of Some Important Families

8.3.1.Fabaceae

- This family was earlier called as Papilionoideae, a sub-family of Leguminosae in Bentham and Hooker's system of classification
- It comprises about 8500 species under 450 genera.
- **Some important plants among these include**: *Arachis hypogaea* (groundnut), *Cajanus cajan* (Red gram, pigeon pea). *Cicer artitetinum* (Bengal gram, chickpea), *Crotalaria juncea* (Sun hemp), *Dolichos lablab* (Bean), *Dalbergia latifolia* (Indian rosewood),*Glycine max* (Soy-

bean), *Derris indica* (Kanuga, Petro plant), *Phaseolus mungo* (Black gram), *Phaseolus aureus* (Green gram), *Pisum sativum* (Garden pea), *Lathyrus sativus* (Wild pea), *Pterocarpus santalinus* (Red sander), *Trigonella foenum graecum* (Fenugreek).

- Floral formula: Br Brl % $K_{(5)}C_{1+2+(2)}A_{(9)+1}G_{1}^{-}$

8.3.2.Solanaceae

- It is commonly called as the 'potato family' and includes about 2200 species belonging to 85 genera
- *Atropa belladonna* (Belladona), Capsicum fruitescens (Chilli), Cestrur-nocturnum (Night queen). Datura metel (Thorn apple),Lycopersicon esculentum-(Tomato), Nicotiana tabacum (Tobacco). Petunia alba (Petunia). Solanum melongena: (Brinjal), Solanum tuberosum (Potato), Withania somnifera (Aswagandha)
- Solanum nigrum (Maku.. kamanchi) plant.
- Floral formula: Br EBrl $\oplus$ $K_{(5)}C_{(5)}A_{5}\underline{G}_{(2)}$

8.3.3.Liliaceae

- This family is commonly called the 'Lily family
- Includes about 254 genera with 4075 species
- Allium cepa (Onion), Allium sativum (Garlic), Aloe vera (Aloe), Asparagus racemosus (Asparagus). Colchicum autumnale (Medow saffron), Dracaena aungustifolia (Red dragon), Gloriosa superba (Glory lily), Lilium candidum (Lily), Smilax zeylanica (Sarasaparilla), Yucca gloriosa (Spanish dagger)
- Floral formula: Br EBrl $P_{(3+3)}A_{3+3}\underline{G}_{(3)}$

DESCRIPTION OF SOME IMPORTANT FAMILIES

1. FAMILY PAPILIONACEAE (FABACEAE)

Plants may be herbs, shrubs, climbers and even trees; leaves generally compound, usually trifoliate, modified partly or wholly into tendril with pulvinus leaf base. Inflorescence is raceme rarely solitary axillary.

Distinguishing features :

(1) Flower perigynous, zygomorphic.

(2) Odd sepal anterior.

(3) Papilionaceous corolla.

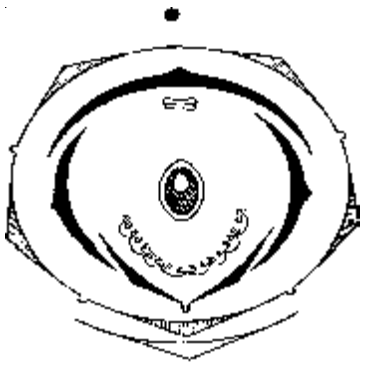
(4) Androecium diadelphous (9+1)

(5) Monocarpellary, unilocular, superior ovary with marginal placentation.

(6) Fruit legume

(7) Seed exalbuminous

(8) Odd petal is posterior



FLORAL DIAGRAM

Economic importance:

Many plants belonging to this family are sources of pulses (gram, arhar, sem, moong, soyabean; edible oil (soyabean, groundnut); blue dye (indigofera); fibres (sunhemp); fodder (Sesbania, Crotalaria, Phaseolus), ornamentals (lupin, sweet pea); medicine (Muliathi, Derris).

Sun-hemp yields fibres, Indian rose-wood yields a dye. Some plants like *Butea monosperma* and *Astragalus gummifer* also produce medicinally useful gum. Soybean and gram are good for the patients of diabetes.

2. FAMILY SOLANACEAE

It is a large family, commonly called '**potato family**' with 85 genera, and 2000 species including 60 from India. Plants mostly herbs, rarely shrubs and trees. Leaves cauline or ramal, simple, exstipulate, petiolate or sessile, arranged alternately, rarely opposite, pinnatedisect in tomato (*Lycopersicom esculentum*).

Inflorescence : Solitary axillary.

Umbellate or scorpioid cyme (*Solanum*)

(1) Sepals five, gamosepalous, persistent, green or coloured, hairy

(2) Petals five, gamopetalous tubular or infundibuliform (Funnel shaped)

(3) Stamens five, epipetalous.

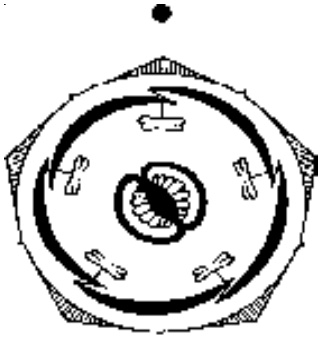
(4) Bicarpellary, syncarpous, ovary superior, bilocular with axile placentation.

(5) Ovary obliquely placed, placenta swollen, many ovules in each locule.

(6) Fruit is berry or capsule.

(7) Endospermic seed.

F.F. $\oplus, \male\!\!\female$ $K_{(5)}$ $\overset{\curvearrowleft}{C_{(5)}}$ A_5 $\underline{G_{(2)}}$



FLORAL DIAGRAM

ECONOMIC IMPORTANCE

Belladona (*Atropa belladonna*) contains atropine alkaloid and used in eye testing and plaster. Nicotine obtained from tobacco is used as an insecticide. The seeds of *Datura,* henbane (*Hyoscyamus niger*), bittersweet, kateli (*Solanum xanthocarpum*) and roots of ashwagandh (*Withania somnifera*) are used medicinally. Tobacco used in bidi, cigarettes, and for chewing is obtained from *Nicotina tobacum*.

3. FAMILY LILIACEAE

Commonly called the '**lily family**' is a characteristic representative of monocotyledonous plants. It includes about 254 genera, and 4075 species, distributed worldwide. About 200 species are available in India.

Vegetative characters: Plants mostly herbs with perennating rhizome or bulb, a few climbers (*Asparagus* and *Smilax*) *Yucca* and *Aloe* are xerophytic; roots are fibrous, tuberous in *Asparagus*; leaves, radical or cauline. In *Asparagus*, the leaves are reduced to minute scales.

Distinguishing features :

(1) Inflorescence : Solitary axillary, scapiferous cyme or cymose umbel.

(2) Flowers hypogynous and trimerous. Bisexual or unisexual (*Smilax* and *Ruscus*)

(3) Perianth 6, in two alternate whorls polyphyllous or gamophyllous.

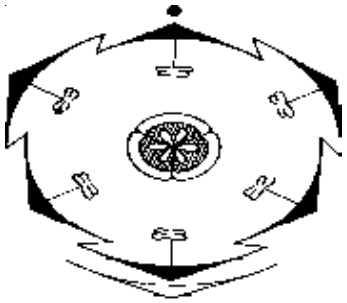
(4) Androecium 6, often epiphyllous, versatile or basifixed anthers.

(5) Tricarpellary, syncarpous, superior, trilocular ovary with axile placentation, stigma trilobed.

(6) Fruit is capsule or berry.

(7) Endospermic seed.

F.F. Br. $\oplus \male\!\!\female$ $\overset{\curvearrowleft}{P_{3+3 \text{ or } (3+3)}}$ A_{3+3} $\underline{G_{(3)}}$



FLORAL DIAGRAM

Economic Importance

Smilax, Aloe, Gloriosa, Colchicum and *Scilla* yields useful drugs. Aloin, a purgative is obtained from *Aloe vera*, rat poison from *Urginea* and *Scilla*, tonic from *Asparagus* (shatavar). *Yucca gloriosa* and *Phormium tenax* produce fibres, *Dracaena* and *Xanthorrhoea* yield resin, used for preparing sealing wax.

MODEL TEST-I

1. Taxonomy based on morphological characters only
   1) Omega taxonomy 2) Alpha taxonomy
   3) Both 1 & 2 4) chemotaxonomy
2. Classification proposed by Theophrastus is
   1) Artificial 2) Natural
   3) Phylogenetic 4) Multidisciplinary
3. Book written by Theophrastus
   1) Species plantarum 2) Historia plantarum
   3) Genera plantarum 4) All
4. Sexual system of classification was proposed by
   1) Theophrastus 2) Leewenhoek
   3) Bentham & Hooker 4) Linnaeus
5. Sexual system of classification is an example.
   1) Artificial 2) Natural
   3) Phylogenetic 4) Multidisciplinary
6. Smallest taxon is
   1) Family 2) Genus 3) Order 4) Species
7. Type of classification followed in Genera plantarum
   1) Natural 2) Artificial 3) Phylogenetic 4) All
8. Number of classes in Genera plantarum
   1) 1 2) 2 3) 3 4) 4
9. Number of cohorts in Thalamiflorae
   1) 4 2) 5 3) 6 4) 3
10. A branch of taxonomy that uses the cytological characters
    1) Numerical Taxonomy 2) Chemotaxonomy
    3) Cytotaxonomy 4) All
11. A branch of taxonomy tht uses the phytochemical data
    1) Cytotaxonomy 2) Chemotaxonomy
    3) Numerial taxonomy 4) None

MODEL TEST - II

12. Correct representation of 3rd whorl of a Brassica flower is
    1) A_6 2) A_{3+3} 3) $A_{(2+4)}$ 4) A_{2+4}
13. Symbol for bracteate flower
    1) Ebr 2) Brl 3) Br 4) Ebrl
14. Zygomorphic flower is represented as
    1) % 2) ⊕ 3) ♀ 4) ♂
15. In a floral diagram mother axis represents
    1) Posterior side 2) Anterior side
    3) Lateral side 4) 1 or 2
16. Mustard belongs to the family
    1) Fabaceae 2) Solanaceae
    3) Brassicaecae 4) Liliaceae
17. Aestivation seen in 2nd whorl of Brassica flower
    1) Twisted 2) Valvate
    3) Quincuncial 4) Imbricate
18. Representation for Inferior ovary
    1) $\underline{G}$ 2) $G-$ 3) $\overline{G}$ 4) G
19.  This condition represents
    1) Episepalous 2) Epiphyllous
    3) Epitepalous 4) Epipetalous
20. Number of carpels in Brassica flower
    1) 2 2) 1 3) 3 4) 4
21. Placentation seen in the ovary of a Brassica flower
    1) Axile 2) Marginal 3) Parietal 4) Basal

MODEL TEST - III

22. Fabaceae belongs to the order
    1) Asterales 2) Rosales
    3) Malvales 4) Polimoniales
23. Most of the Fabaceae members are
    1) Mesophytes 2) Xerophytes
    3) Hydrophytes 4) None
24. Number of species included under Fabaceae
    1) 270 2) 8500 3) 4075 4) 2200
25. A bacterium that forms root nodules with Fabaceae members
    1) Rhizobium 2) Clostridium
    3) Azotobacter 4) Chlorobium
26. Type of inflorescence in Fabaceae members
    1) Raceme 2) Cyme
    3) Verticellaster 4) Hypenthodium
27. Number of stamens found in a flower of Pisum
    1) 9 2) 10 3) 6 4) 5
28. Number of carpels in a flower of Fabaceae member
    1) 1 2) 2 3) 3 4) 4
29. Seeds of Fabaceae members are
    1) Non - endospermic 2) Endospermic
    3) Monocotyledons 4) Both 1 & 3

30. Soyabean oil is obtained from
    1) Arachis 2) Glycine
    3) Crotalaria 4) Derris
31. Blue dye is obtained from
    1) Indigofera 2) Sesbania
    3) Tephrosia 4) Butea
32. Ornamental Fabaceae member is
    1) Sesbenia 2) Trifolium
    3) Tephrosia 4) Dolichos
33. Monocarpellary , Unilocular , Half- superior ovary flowers are found in
    1) Fabaceae 2) Solanaceae
    3) Liliaceae 4) Brassicaceae
34. Characteristic fruit of Fabaceae members is
    1) Sliliqua 2) Loculicidal capsule
    3) Schizocarp 4) Legume

MODEL TEST - IV

35. Number of genera in Solanaceae family
    1) 80 2) 85 3) 2200 4) 4500
36. Common name of Withania somnifera is
    1) Belladona 2) Kamanchi
    3) Aswagandha 4) Night queen
37. Type of vascular bundles seen in the stem of Solanaceae members
    1) Conjoint, collateral
    2) Radial (or) Separate
    3) Bicollateral 4) Amphicribal.
38. Phyllotaxy in Solanaceae members
    1) Alternate 2) Whorled
    3) opposite 4) All
39. Flowers of Solanaceae are
    1) Hypogynous 2) Perigynous
    3) Epigynous 4) 1 & 2
40. Type of inflorescence seen in Datura
    1) Axillary solitary cyme
    2) Scorpioid cyme
    3) Terminal solitary cyme 4) Panicle
41. Family Solanaceae belongs to the series
    1) Inferae 2) Heteromerae
    3) Bicarpellatae 4) Calicyflorae
42. Placentation seen in the flowers of Solanaceae members
    1) Marginal 2) Axile
    3) Perietal 4) Basal
43. Solanaceae member with Protogynous flowers
    1) Datura 2) Nicotiana
    3) Cestrum 4) Solanum
44. Fruit of Lycopersicon is
    1) Berry 2) Pome
    3) Pepo 4) Hesperidium
45. Medicinal plant of Solanaceae
    1) Belladona only 2) Aswagandha only
    3) Kamanchi only 4) 1, 2 & 3
46. Alkaloid obtained from Tobacco plant is
    1) Capsanthin 2) Atropin
    3) Nicotin 4) All
47. Ornamental plant of Solanaceae
    1) Petunia 2) Solanum
    3) Withania 4) Capsicum

MODEL TEST - V

48. Xerophytic member of Liliaceae
    1) Asparagus only 2) Ruscus only
    3) Aloe only 4) 1, 2 & 3
49. A Liliaceae member with fasciculated tuberous roots
    1) Dahlia 2) Ruellia 3) Asparagus 4) Smilax
50. Radical leaves are found in
    1) Smilax 2) Gloriosa
    3) Allium 4) Dracaena
51. Flowers of Liliaceae members are
    1) Trimerous, hypogynous
    2) Tetramerous, hypogynous
    3) Trimerous, epigynous
    4) Tetramerous, epigynous
52. Number of Tepals in a flower of Smilax
    1) 3 2) 6 3) 5 4) 4
53. Find the plant with Tricarpellary ovary in the flowers
    1) Brassica 2) Solanum
    3) Smilax 4) Lupine
54. Liliaceae members with protogynous flowers
    1) Asparagus 2) Allium
    3) Colchicum 4) Solanum
55. Fruit in Asparagus
    1) Berry 2) Loculicidal capsule
    3) Gloriosa 4) Pome
56. Polyembryony is seen in the seeds of
    1) Allium 2) Solanum
    3) Trifolium 4) Trigonella

57. Colchicine is an alkaloid obtained from
1) Seeds of Allium 2) Corm of colchicum
3) Seeds of colchicum 4) Seeds of Gloriosa

58. Stem modification in *Gloriosa*
1) Rhizome 2) Corm
3) Stem tuber 4) Bulb

59. Bulb is seen in
1) Allium only 2) Lilium only
3) Scilla only 4) 1, 2 & 3

60. Liliaceae member with cylindrical cladophylls
1) Asparagus 2) Ruscus
3) Allium 4) 1 & 2

61. A Liliaceae member that shows symbiotic cross pollination is
1) Asparagus 2) Ruscus
3) Yucca 4) Solanum

62. Ornamental plant of Liliaceae
1) Gloriosa 2) Ruscus
3) Allium 4) Colchicun

QUESTION BANK
TYPE - I

63. Who proposed the natural system of classification?
1) Carolus Linnaeus
2) John Hutchinson
3) Bentham & Hooker
4) Oswald Tippo

64. The system of plant classification proposed by Carolus Linnaeus was artificial because
1) It took into account the physiological facts along with the morphological characters
2) It was based on evolutionary relationship of plants
3) It is based on similarities and differences in floral & other morphological characters only
4) None of the above

65. The first artificial system of plant classification was proposed by
1) Bauhin 2) Caesalpino
3) Theophrastus 4) Aristotle

66. In which century, Linnaeus proposed the system of classification?
1) 16th 2) 15th 3) 17th 4) 18th

67. Linnaeus system of plant classification is
1) Artificial 2) Natural
3) Phylogenetic 4) None

68. The book 'Genera Plantarum' was written by
1) Bessey 2) Hutchinson
3) Engler & Prantl 4) Bentham & Hooker

69. The system of Bentham & Hooker includes the following number of families
1) 202 2) 186 3) 196 4) 206

70. Bentham & Hooker differentiate series in Monochlamydeae numbering
1) Five 2) Seven 3) Eight 4) Ten

71. According to Bentham & Hooker's system the family Solanaceae be placed under the order
1) Gentianales 2) Polemoniales
3) Campanales 4) Solanales

72. Which of the following plants produces edible roots?
1) *Raphanus sativus* 2) *Brassica campestris*
3) *Brassica oleracea* 4) *Eruca sativa*

73. The flower of *Brassica* is
1) Tetracyclic 2) Pentacyclic
3) Tricyclic 4) Polycyclic

74. The anthers of Malvaceae are
1) Dithecous, introrse
2) Monothecous, extrorse
3) Monothecous, introrse
4) Dithecous, extrorse

75. The whorl and position of short stamens in Cruciferae
1) Outer, lateral 2) Outer, antero-posterior
3) Inner, lateral 4) Inner, antero-posterior

76. Which of the following is an ornamental climber of Papilionaceae?
1) *Erythrnia* 2) *Lupinus*
3) *Clitoria* 4) *Dalbergia*

77. The botanical name of black gram is
1) *Cicer mungo* 2) *Vicia mungo*
3) *Cyamopsis mungo* 4) *Vigna mungo*

78. The botanical name of pigeon pea is
1) *Cajanus* 2) *Cyamopsis*
3) *Cicer* 4) *Vicia*

79. The 10^{th} stamen in the flower of Pisum is placed
1) Anteriorly 2) Antero-laterally
3) Posteriorly 4) Postero-laterally

80. A blue coloured dye is obtained from a papilionaceous plant
1) *Indigofera* 2) *Erythrina*
3) *Pterocarpus* 4) *Psoralia*

81. Which of the following is a fiber-yielding plant?
1) Pongamia 2) Trigonella
3) Dalbergia 4) Sesbania

82. The floral formula of Papilionaceae is
1) $\oplus \, ♂♀ K_{(5)} C_{(5)} A_{10} \underline{G_1}$
2) % $♂♀ K_{(5)} C_{1+2} A_{(9)+1} \underline{G_1}$
3) % $♂♀ K_5 C_{1+2+(2)} A_{(9)+1} \underline{G_1}$
4) % $♂♀ K_{(5)} C_{(5)} A_{(9)+1} \underline{G_1}$

83. The plants of *Gloriosa* climb by means of
1) Leaflet tendrils 2) Stem tendrils
3) Stipular tendrils 4) Leaf apex tendrils

84. *Pronuba* pollinates the flower of
1) *Yucca* 2) *Tulipa* 3) *Allium* 4) *Ruscus*

85. The type of inflorescence present in *Allium* is precisely
1) Cyme 2) Umbel
3) Umbellate cyme 4) Spikate cyme

86. The gynoecium in Liliaceae is usually
1) Tricarpellary, syncarpous
2) Tricarpellary, apocarpous
3) Tetracarpellary, syncarpous
4) Tetracarpellary, apocarpous

87. A distinct monocot character shown by the flowers of Liliaceae is
1) Hypogynous 2) Actinomorphic
3) Trimerous 4) Bisexual

88. Stamens in Solanaceae are:
1) Epiphyllous 2) Synandrous
3) Syngenesious 4)Epipetalous

89. The floral formula of *Allium cepa* is :
1) $\oplus ♂♀ P_{3+3 \text{ or } (3+3)} A_{3+3} \underline{G_{(3)}}$
2) $\oplus ♂♀ P_{3+3} A_{3+3} \underline{G_{(2)}}$
3) $\oplus ♂♀ K_5 C_5 A_4 \underline{G_{(9)}}$ 4) None of the above

90. The floral formula of *Petunia alba* is :
1) $\oplus ♂♀ K_{(5)} C_{(5)} A_5 \underline{G_{(2)}}$
2) $\oplus ♂♀ K_{(5)} C_{(5)} A_{(5)} \underline{G_{(2)}}$
3) $+ ♂♀ K_{(5)} C_{(5)} A_{(5)} \underline{G_{(5)}}$
4) All of these

91. (9) + 1 condition of androecium is found in one of the families :
1) Caesalpiniaceae 2) Papilionaceae
3) Malvaceae 4) Rutaceae

TYPE - II

92. Which of the following statements regarding family Brassicaceae is correct ?
1) Flowers bisexual, cruciform corolla
2) Stamens usually 6, tetradynamous
3) Inflorescence typically racemose or corymbose raceme
4) All of these

93. Axile placentation occurs in
1) Asteraceae and Fabaceae
2) Brassicaceae and Solanaceae
3) Solanaceae and Liliaceae
4) All of these

94. A diagnostic trait for identification of fabaceous flower is
1) Tetradynamous androecium
2) Inferior ovary
3) Cruciform corolla
4) Vexillary aestivation

95. Which of the following is not correctly paired
1) Fabaceae : Legume family
2) Solanaceae : Potato family
3) Liliaceae : Sunflower family
4) Brassicaceae : Mustard family

96. Flower of Fabaceae is
1) Complete, zygomorphic, pentamerous
2) Complete, actinomorphic, trimerous
3) Incomplete, zygomorphic, trimerous
4) Incomplete, actinomorphic, pentamerous

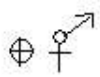
97. Familiar examples of family Liliaceae are
1) Allium cepa, Aloe vera and Tamarindus indica
2) Saraco indica, Allium cepa and Aloe vera
3) Tamarindus indica, Allium cepa and Allium sativum
4) Tamarindus indica, Allium cepa and Allium sativum

98. Bicarpellary, syncarpous, unilocular ovary with basal placentation occurs in
1) Liliaceae 2) Solanaceae
3) Asteraceae 4) Fabaceae

99. Which of the following is correct with reference to flowers of family solanaceae
1) Pentamerous, actinomorphic, unisexual, hypogynous
2) Pentamerous, zygomorphic, bisexual, epigynous
3) Pentamerous, bisexual, actionomorphic, hypogynous
4) Trimerous, actinomorphic, bisexual, hypogynous

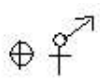
100. Which of the following represents the floral characters of Liliaceae
1) Six, tepals, zygomorphic, six stamens, bilocular ovary, axile placentation
2) Tetramerous, actinomorphic, polyphyllous, unilocular ovary, axile placentation
3) Trimerous, actinomorphic, polyandrous, superior ovary, axile placentation
4) Unisexual, actinomorphic, trilocular, inferior ovary, axile placentation

101. Consider the following four statements A, B, C and D and select the right option for two correct statements
A) In vexillary aestivation, the large posterior petal is called - standard, two lateral ones are wings and two small anterior petals are termed keel
B) The floral formula for Liliaceae is



$P_{3+3}A_{3+3}+G_{\underline{3}}$

C) In pea flower the stamens are monadelphous
D) The final formula for Solanaceae is



$K_{(3)}C_{(3)}A_{(4)}+G_{\underline{(2)}}$

The correct statements are
1) A and C 2) A and B
3) B and C 4) C and D

102. Which of the character does not become apparent in floral formula
1) Placentation and aestivation
2) Number of floral parts
3) Whorls of floral parts
4) Position of ovary

103. The family containing mustard and its main characters are
1) Brassicaceae-Tetramerous flowers six stamens, bicarpellary gynoecium, siliqua type fruit
2) Brassicaceae-Pentamerous flowers, many stamens, pentacarpellary gynoecium, capsule type fruit
3) Solanaceae - Pentamerous flowers, five stamens, bicarpellary gynoecium, berry type fruit
4) Poaceae-Trimerous flowers, three stamens monocarpellary gynoecium, caryopsis type of fruit.

104. Which of the following are not characteristic features of Fabaceae
1) Tap root system, compound, leaves and raceme inflorescence
2) Flowers actinomorphic, twisted aestivation and gamopetalous
3) Stamens 10, introrse, basifixed, dithecous
4) Monocarpellary, ovary superior and bent stigma
5) Fruit is legume

105. Which of the following is not a characteristic feature of Fabaceae
1) Descendingly imbricate, ten stamens, diadelphous ovary half superior
2) Monocarpellary ovary, superior, style long, slightly bent at the apes
3) Zygomorphic flowers, diadelphous stamens, many ovules
4) Corolla five petals, polypetalous, anterior one large and outermost

106. Papilionaceous flower with large vexillum covering two wings and the wings covering the level has corolla aestivation of
1) Descending imbricate
2) Ascending imbricate
3) Twisted 4) Valvate

TYPE - III

107. Match the List - I with List - II and find the correct combination

List - I	List - II
A) Theophrastus	I) Die Naturulichen planzenfamilien
B) Linnaeus	II) Genera plantarum
C) Bentham & Hooker	III) Species plantarum
D) Engler & Prantl	IV) Historia plantarum

	A	B	C	D
1)	II	III	I	IV
2)	I	II	IV	III
3)	IV	III	II	I
4)	IV	II	III	I

108.

List - I	List - II
A) Ground nut	I) Lathyrus sativus
B) Red gram	II) Cajanus cajan
C) Sun hemp	III) Arachis hypogea
D) Wild pea	IV) Crotalaria juncea

	A	B	C	D
1)	II	IV	III	I
2)	III	II	IV	I
3)	III	IV	II	I
4)	II	III	I	IV

109.

List - I	List - II
I) Red gram	A) Sesbania
II) Ground nut	B) Edible oil
III) Indigofera	C) Pulse
IV) Green manure	D) Blue dye

	I	II	III	IV
1)	B	C	A	D
2)	B	A	D	C
3)	C	D	B	A
4)	C	B	D	A

110.

List - I	List - II
A) Bicollateral vascular bundles	I) Fabaceae
B) Half inferior ovary	II) Asteraceae
C) Epicalyx	III) Malvaceae
D) Inferior ovary	IV) Solanaceae

1) A - IV, B - I, C - III, D - II
2) A - I, B - III, C - II, D - IV
3) A - II, B - I, C - III, D - IV
4) A -IV, B-II , C - I , D - III

111.

List - I	List - II
A) Belladona	I) Atropa
B) Aswagandha	II) Solanum nigrum
C) Kamanchi	III) Withania
D) Thorn apple	IV) Datura

1) A - I, B - III, C - II, D - IV
2) A - III, B - II, C - I, D- IV
3) A - I, B - IV, C - II, D - III
4) A - II, B - III, C - I, D - IV

112.

List - I	List - II
A) Ornamental plant	I) Asparagus
B) Medicinal plant	II) Smilax
C) Vegetable	III) Gloriosa
D) Spice	IV) Allium sativum

1) A - III, B - I, C - IV, D - III
2) A - II, B - I, C - III, D - IV
3) A - III, B - II, C - I D - IV
4) A - I , B - II, C - III, D - IV

EXERCISE - IV

113.

Plant	**Fruit**	**Family**
I) Arachis	Pod	Fabaceae
II) Nicotiana	Septifragal capsule	Liliaceae
III) Gloriosa	Septicidal capsule	Liliaceae
IV) Helianthus	Cypsela	Asteraceae

Find the incorrect combinations from the table given above

1) II & III only 2) IV only
3) Except II 4) II only

114.

Plant	**Fruit**	**Family**
I) Solanum	Axillary scorpioid cyme	Solanaceae
II) Allium	Polyembryony	Liliaceae
III) Dolichos	Twiner	Fabaceae
IV) Abutilon	Epicalyx is absent	Malvaceae

The correct combinations are

1) I only 2) I & II only
3) I, II, III only 4) I, II, III, IV

115.

Plant	**Economically Useful part**	**Use**
A. Colchicum	Seed	Chemical mutagen
B. Derris	Seed	Oil is used for making medicines
C. Solanum nigram	Fruits	Edible with medical value
D. Aloe	Leaves	Cures piles

The correct combinations are

1) ABCD 2) A only
3) A & B only 4) A,B,C only

116.

Plant	**Character-1**	**Character-2**
I) Hibiscus	Monothecous anthers	Petals fused with staminal tube at the base
II) Crotalaria	Perigynous Flower	Superior ovary
III) Nicotiana	Panicle inflorescence	Self pollination
IV) Aloe	Gamophyllous perianth	simple race mose inflorescence

The correct combination are

1) I only 2) I & II only
3) I, II, III only 4) I, II, III, IV

117.

	Family	**Scientific name of plant**	**Common name**
A)	Brassicaceae	Brassica nigra	mustard
B)	Fabaceae	Derris indica	kanuga
C)	Solanaceae	Solanum tuberosum	Potato
D)	Liliaceae	Yucca gloriosa	Spanish dagger
E)	Malvaceae	Althea rosea	Ganga ravi

The incorrect combination is

1) D & E 2) E only
3) A,B,C,D,E 4) A,B,C

EXERCISE - V

118. The **correct** floral formula of chilly is:

[CBSE Pre 2011]

1) $\oplus \varphi \sigma K_{(5)} C_{(5)} A_{(5)} \underline{G_2}$

2) $\oplus \varphi \sigma K_5 \overset{\frown}{C_5} A_{(5)} \underline{G_2}$

3) $\oplus \varphi \sigma K_{(5)} C_5 A_5 \underline{G_{(2)}}$

4) $\oplus \varphi \sigma K_{(5)} \overset{\frown}{C_{(5)}} A_5 \underline{G_{(2)}}$

119. Flowers are Zygomorphic in:

[CBSE Pre 2011]

1) Tomato 2) Datura
3) Mustard 4) Gulmohur

120. The correct floral formula of soyabean is

[CBSE 2010]

1) $\% \, \varphi \sigma \, K_{(5)} C_{1+2+(2)} A_{(9)+1} \underline{G_1}$

2) $\% \, \varphi \sigma \, K_{(5)} C_{1+2+(2)} A_{1+(9)} \underline{G_1}$

3) $\% \, \varphi \sigma \, K_{(5)} C_{1+(2)+(2)} A_{(9)+1} \underline{G_{\bar{1}}}$

4) $\% \, \varphi \sigma \, K_5 C_{1+(2)+2} A_{(9)+1} \underline{G_1}$

121. Keel is characteristic of the flowers of:
[CBSE-Pre 2010]
1) *Calotropis* 2) Bean
3) Gulmohur 4) *Cassia*.

122. Pentamerous, actinomorphic flowers, bicarpellary ovary with oblique septa, and fruit a capsule or berry, are characteristic features of
[CBSE 2006]
1) Liliaceae 2) Asteraceae
3) Brassicaceae 4) Solanaceae

123. The 'Species Plantarum' was written by **(BHU 1990)**
1) Joseph Hokker 2) John Ray
3) Charles Darwin 4) Carolus Linnaeus

124. Bentham & Hooker divided plants into the following groups **(AFMC 1993)**
1) Dicots, Gymnospermae & Monocots
2) Angiospermae & Gymnospermae
3) Cryptogams & Phanerogams
4) Cellulare & Vasculare

125. Phylogenetic classification is based on **(CBSE 2001)**
1) Habits of plants 2) Utilitarian system
3) Overall similarities
4) Common evolutionary descent

126. Who proposed 'Five Kingdom Classification' of organisms? **(PMT-MP 2000)**
1) Whittaker 2) Bentham
3) Linnaeus 4) Magnus

127. Who is the father of Botany? **(PMT-Raj.2001)**
1) Mendel 2) Theophrastus
3) Robert Hooke 4) Louis Pasteur

128. An example for the artificial system of classification **(PMT-Kerala 2004)**
1) Bentham & Hooker 2) Linnaeus system
3) Engler & Prantl 4) Bessey

129. Phylogenetic system of classification was proposed by **(PMT-Pun.2004)**
1) Linnaeus 2) Bentham
3) Hutchinson 4) Theophrastus

130. Which one of the following yields valuable timber? **(CPMT-UP 1991)**
1) *Acacia arabica* 2) *Dalbergia sisso*
3) *Mangifera indica* 4) *Prosopis specigera*

131. Where would you place a plant having bicollateral vascular bundles, a climbing stem & unisexual flowers? **(CPMT-UP 1991)**
1) Papilionaceae 2) Compositae
3) Cucurbitaceae 4) Liliaceae

132. Pulses yielding main family of plants is **(CBSE 1993, JIMPER 94, PMT-MP 98)**
1) Poaceae 2) Cucurbitaceae
3) Liliaceae 4) Papilionaceae

133. The following aspect of the flower can be depicted in the floral formula but not in floral diagram **(AMU 1997)**
1) Symmetry of the flower
2) Aestivation or sepals & petals
3) Cohesion of floral part
4) Position of the ovary

134. In Fabaceae, the type of placentation is **(PMT-Raj. 2000)**
1) Perietal 2) Marginal
3) Axile 4) All of the above

135. The floral formula, Ebr $\oplus$ ♀$K_5C_{(5)}A_0\overline{G_{(3)}}$ belongs to family **(CPMT-UP 2001)**
1) Solanaceae 2) Gramineae
3) Cucurbitaceae 4) Liliaceae

136. The floral formula of Solanaceae is **(CBSE 1991, 92; DPMT 97; PMT-Raj. 97; AFMC 98; BHU 98)**
1) $\otimes$ ♂♀$K_5\underline{G_{(2)}}$ 2) $\oplus$ ♂♀$K_{(5)}\overline{\underline{G_{(2)}}}$
3) † ♂♀$K_{(5)}\ \underline{G_{(2)}}$ 4) $\oplus$ ♂♀$K_5\ C_5\ A_5\ \underline{G_{(2)}}$

137. The carpels are obliquely placed in **(AFMC 1994)**
1) Brassicaceae 2) Solanaceae
3) Liliaceae 4) Asteraceae

138. *Datura* belongs to family **(AFMC 1996)**
1) Compositae 2) Cruciferae
3) Liliaceae 4) Solanaceae

139. The correct botanical name of tomato is **(AFMC 1997)**
1) Solanum nigrum 2) Lycopersicon esculentum
3) Solanum melongena 4) Solanum eculentum

140. Epipetalous stamen, obliquely placed septum, swollen placenta and berry or capsule fruit are diagnostic features of family **(PMT - 2001)**
1) Cruciferae 2) Solanaceae
3) Malvaceae 4) Labiatae

141. Which of the following statements is correct with reference to the flowers of family Solanaceae ?
(CET - 2003)
1) Penatamerous, bisexual, actionomorphic, hypogynous
2) Trimerous, actinomorphic, bisexual, hypogynous
3) Pentamerous, actinomorphic, unisexual, hypogynous
4) Pentamerous, Zygomorphic, bisexual, epigynous

142. $\oplus \, ♀ \, \overset{\frown}{P_{3+3}} \, A_{3+3} \, \underline{G_{(3)}}$ is the floral formula of
(PMT- 1992)
1) Brassicaceae 2) Liliaceae
3) Poaceae 4) Musaceae

143. The correct floral formula of Liliaceae is
(BHU 1995, 2000)
1) $\oplus \, ♀ \, P_{3+3} \, A_6 \, \underline{G_{(3)}}$
2) $\oplus \, ♀ \, P_{3+3} \, A_{3+3} \, \underline{G_{(3)}}$
3) $\% \, ♀ \, P_{3+3} \, A_{3+3} \, \underline{G_{(3)}}$
4) $\% \, ♀ \, P_{3+3} \, A_{3+3} \, \underline{G_{(6)}}$

144. Liliaceae flowers are **(PMT - 2002)**
1) Trimerous 2) Tetramerous
3) Pentamerous 4) Zygomorphic

KEY

MODEL TEST - I

1) 2	2) 1	3) 2	4) 4	5) 1	6) 4
7) 1	8) 3	9) 3	10) 3	11) 2	

MODEL TEST - II

12) 4	13) 3	14) 1	15) 1	16) 3	17) 2
18) 3	19) 4	20) 1	21) 3		

MODEL TEST - III

22) 2	23) 1	24) 2	25) 1	26) 1	27) 2
28) 1	29) 1	30) 2	31) 1	32) 2	33) 1
34) 4					

MODEL TEST - IV

35) 2	36) 3	37) 3	38) 1	39) 1	40) 3
41) 3	42) 2	43) 4	44) 1	45) 4	46) 3
47) 1					

MODEL TEST - V

48) 4	49) 3	50) 3	51) 1	52) 2	53) 3
54) 3	55) 1	56) 1	57) 3	58) 1	59) 4
60) 1	61) 3	62) 1			

QUESTION BANK

TYPE - I

63) 3	64) 3	65) 3	66) 4	67) 1	68) 4
69) 1	70) 3	71) 2	72) 1	73) 2	74) 2
75) 1	76) 3	77) 4	78) 1	79) 4	80) 1
81) 4	82) 3	83) 4	84) 1	85) 3	86) 1
87) 3	88) 4	89) 1	90) 1	91) 2	

EXERCISE - II

TYPE - II

92) 4	93) 3	94) 4	95) 3	96) 1	97) 3
98) 3	99) 3	100) 3	101) 2	102) 1	103) 1
104) 2	105) 4	106) 1			

TYPE - III

107) 3	108) 2	109) 4	110) 1	111) 1	112) 3

TYPE - IV

113) 4	114) 4	115) 1	116) 3	117) 2

TYPE - V

118) 4	119) 4	120) 2	121) 2	122) 4	123) 4
124) 1	125) 4	126) 1	127) 2	128) 2	129) 3
130) 3	131) 2	132) 4	133) 2	134) 2	135) 3
136) 3	137) 2	138) 4	139) 2	140) 2	141) 1
142) 2	143) 2	144) 1			

.SYNOPSIS

What is Cell?

- All organisms are composed of cells.
- Some organisms are made up of a single cell and these are called **Unicellular organisms.**
- Some organisms composed by many cells are called **Multicellular organsims.**
- Unicellular organisms are capable of
  i) independent existence
  ii) performing the essential functions of life
- Cell is the fundamental structural and functional unit of all living organisms.

CELL THEORY

- **Cell theory** was put forward by **Schleiden** and **Schwann** which states that "the bodies of all living beings are formed of cells and their products and that the cells are structural and functional units of living being".
- **M.J.Schleiden** was a German Botanist published his findings in 1838.
  i) All types of plant tissues are made of one or other type of cells.
  ii) Cells are structural units of all plant tissues.
  iii) Each cell has a boundary namely cell wall and nuclear core surrounding by jelly.
- **Theodore Schwann** was a German Zoologist who found that animal tissues were made of cells and that animal cells differ from plant cells in lacking cell wall. He therefore defined cell as membrane enclosed, nucleus containing structure.
- This theory however didnot explain as to how new cells were formed.
- **Rudolf Virchow** first explained that cells divide and new cells are formed from pre-existing cells(Omnis Cellula-e-Cellula).
- He modified the hypothesis of **Schleiden** and **Schwann** to give the cell theory a final shape.
- Two basic aspects of cell theory are
  i) Body of all living organisms made of cells and their products.
  ii) Cells develop from pre-existing cells.

AN OVERVIEW OF CELL

- The Onion cell which is a typical plant cell has a distinct cell wall.
- The cells of the human cheek have an outer membrane as the delimiting structure of the cell.
- Cells that have membrane bound nuclei are called **Eukaryotes**, where as cells that lack a membrane bound nucleus are called **Prokaryotes**.
- In both the cells cytoplasm occupies the volume of the cell. It is a semifluid matrix.
- In plants and animal cells cytoplasm is the main site of cellular activities.
- Various chemical reactions occur in cytoplasm and keep the cell in the 'living state'.
- Eukaryotic cells have membrane bound organelles like **endoplasmic reticulum**, **golgi complex, lysosomes**, **mitochondria, plastids(in plants)**, **microbodies and vacuoles.**
- In Prokaryotic cells membrane bound organelles are absent.
- Ribosomes are non-membrane bound organelles found in both eukaryotic as well as prokaryotic.
- These ribosomes not only present in cytoplasm but also found in **chloroplast**(in plants), **mitochondria** and on **rough ER**.
- Prokaryotes contain 70s types of ribosome, where as in eukaryotes 80s (in cytoplasm, ER) 70s(in chloroplast and mitochondria).
- Animal cells contain another non-membrane bound organelle called **centriole** which help in cell division.

PROKARYOTIC CELLS

- These are represented by bacteria, blue-green algae, mycoplasma(PPLO).
- They are generally smaller and multiply more rapidly than the eukaryotic cells.
- They may vary greatly in shape and size.

Cell Size:

- Cells are generally small. They cannot be observed with the naked eye. Microscopes are used to observe them.

Organism	*Size*
Mycoplasma (or) PPLO	0.3µm in length
Bacteria	3 to 5µm
Human RBC	7.0µm in diameter
Unicellular eukaryotes	10 to 20µm
Nerve cells are longest	90cm in human
Egg of Ostrich (largest isolated single cell)	17.5x15.0cm

Shapes of Cells

Shape	Examples
Round and biconcave	Red blood cells
Amoeboid	White blood cells
Long and narrow	Epithelial cells
Branched and long	Nerve cell
Elongated	Tracheid of xylem
Round and Oval	Mesophyll cells

Bacteria appear in the following shapes

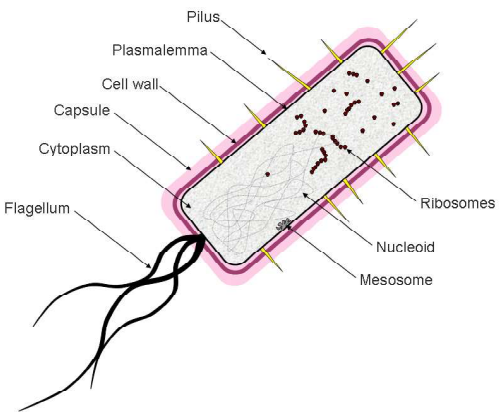
Cocci : They are spherical shaped. They appear is monococcus (single) , diplococcus (two),streptococcus (long chain) , tetra coccus (four) sarcina (eight arranged like a cube) and staphylococcus (Many in irregular shape)

Bacilli : They are rod shaped and appear as mono, diplo and streptobacillus

Vibrios : They are comma shaped bacteria

Spirilla : They are spiral shaped bacteria

- All prokaryotes have a cell wall surrounding the cell membrane.



Cell wall.

- The fluid matrix filling the cell is cytoplasm.
- Well defined nucleus is absent. Genetic material is naked, circular called **nucleoid**.
- Many bacteria have small circular DNA outside the genomic DNA. These are called **plasmids**. They create resistance to antibiotics.
- Plasmid DNA is used to monitor bacterial transformation with foreign DNA.

Cell envelope and its modifications:

- Bacterial cells, have a chemically complex cell envelope.
- Cell envelope consists of a tightly bound three layered structure.
- The outermost glycocalyx followed by the cell wall and then plasma membrane.
- Each layer of the envelope performs distinct function, they act together as a single protective unit.
- Staining procedure developed by **Gram**.
- Based on this he classified bacteria into two groups. Those are **Gram positive** and **Gram negative**.
- Glycocalyx differs in composition and thickness among different bacteria.
- Loose sheath of glycocalyx is called **slime layer**.
- Thick and tough nature of glycocalyx is called **capsule**.
- Cell wall determines the shape of the cell and provides support to prevent the bacterium from bursting or collapsing.
- Plasma membrane is semi-permeable in nature. It is structurally similar to that of the eukaryotes.
- Extensions of plasma membrane into cytoplasm are called **mesosomes**. These extensions are in the form of vesicles, tubules and lamellae.

Functions of mesosomes:

(i) They help in cell wall formation.

(ii) Help in DNA replication and its distribution to daughter cells.

(iii) They help in respiration, secretion processes, to increase the surface area of the plasma membrane.

(iv) Help in absorption of nutrients and enzymatic content.

- In Cyanobacteria **chromatophores** are present.
- Flagella may be present or absent.
- Flagella composed by 3 parts -
  (i) filament (ii) hook (iii) basal body
- Flagella made up of a protein called **flagellin**. They help in movement
- Pili & Fimbriae are help to attach the bacteria to rocks in streams and also to the host tissues.

RIBOSOMES AND INCLUSION BODIES

- These are submicroscopic, naked ribonucleoprotein granular organelles.
- They are about 15nm by 20nm in size.
- Type of ribosome is 70s, subunits are 50s and 30s. Both these subunits are attached by Mg^{2+} ion.
- Ribosomes are the sites of protein synthesis. Those are called **protein factories**.
- Several ribosomes may attach to a single mRNA and form a chain called **polysomes** or **polyribosome**.
- **Palade** studied ribosomes in animal cells.
- Ribosomes are also called **palade particles**.
- In prokaryotes ribosomes are synthesised in the **cytoplasm**.
- Ribosome proteins are formed over ribosomes with the help of mRNAs which are **polycistronic**.

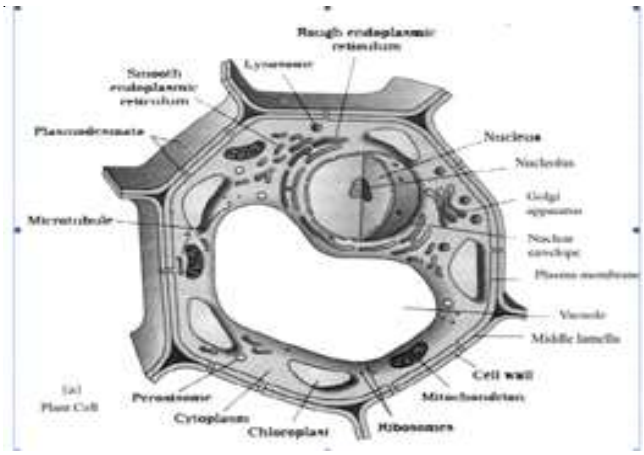
INCLUSION BODIES:

- Reserve materials are stored in the cytoplasm in the form of **inclusion bodies**.
- These are not bounded by any membrane system and lie free in the cytoplasm.
  Eg: Phosphate granules, cyanophycean granules and glycogen granules.
- Gas vacuoles are found in blue green, purple and green photosynthetic bacteria.

EUKARYOTIC CELLS

- **Protists, Plants, Animals** and **Fungi** are includes under eukaryotes.
- Membrane bound organelles, nucleus with nuclear envelop, variety of complex locomotory and cytoskeletal structures are present in cytoplasm.
- Genetic material is organised into chromosomes.
- All eukaryotic cells are not identical.

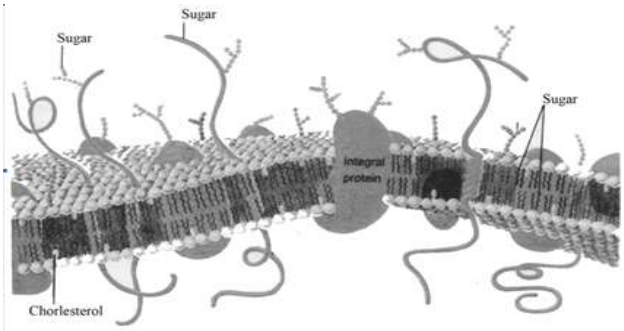
	Plant cell	*Animal cell*
Cell wall	present	absent
Plastids	present	absent
Vacuole	present	absent
Centriole	absent	present



Cell Membrane:

- Detailed structure of the membrane was studied by using **electron microscope**.
- Intracellular biomembranes are found in eukaryotic cells around most cell organelles as well as inside some cell organelles.
  Eg: Tonoplast around vacuole.
- Double membrane covering is present around nucleus, mitochondria and plastids.
- Single membrane covering is present around **ER, GC, Lysosomes, Peroxisomes & Glyoxysomes.**
- Cell membrane is composed of lipids that are arranged in a bilayer.
- Lipids are arranged within the membrane with the polar(hydrophilic) head towards the outer sides and the hydrophobic tails towards the inner part.
- Lipid component of the membrane mainly consists of phosphoglycerides.
- Cell membrane also possess protein and carbohydrates.
- The ratio of protein and lipid varies considerably in different cell types.
- In human beings, the membrane of the erythrocyte has approximately **52%** of protein and **40%** lipids.
- Membrane proteins can be classified as integral and peripheral.

- Peripheral proteins lie on the surface of membrane while the integral proteins are partially or totally burried in the membrane.



- Different models of molecular structure of plasma membrane have been proposed by different scientists.
- Highly acceptable model of cell membrane was proposed by **Singer & Nicolson** widely accepted as **fluid mosaic model.**
- According to this quasi-fluid nature of lipid enables lateral movement of proteins with the overall bilayer.
- Fluid nature of the membrane is also important for cellular functions like
  * Cell growth
  * Formation of intercellular junctions
  * Secretion
  * Endocytosis
  * Cell division
- Important function of the plasma membrane is the transport of the molecules into and out of the cells.
- The membrane is **selectively permeable** to some molecules present on either side of it.
- Many molecules can move briefly across the membrane without any utilization of energy is called the **passive transport**.

  Eg: 1) Solutes may move across the membrane by simple diffusion along the concentration gradient(from higher concentration to the lower).

  2) Movement of water by diffusion across the membrane is called **osmosis**.
- Few ions or molecules are transported across the membrane through its carrier proteins against their concentration gradient(from lower to the higher concentration).
- Such transport is an energy dependent process, in which ATP is utilised and is called **active transport**.

  Eg: Na^+/K^+ pump.

FUNCTIONS OF PLASMA MEMBRANE

1. The cell membrane maintains the individuality and form of the cell and its organelles
2. A cell remains dynamic as long as the plasma membrane is able to determine which material should enter or leave the cell. Cell membrane helps in regulating the flow of materials and energy into and out of the cell through the processes of diffusion, osmosis (passive) and active transport. (Na^+ - K^+ pump).

CELL WALL:

- It is a rigid, semi-elastic, semi-transparent supportive and protective covering of cell in **Plants, Fungi, Prokaryotes** and some **Protists.**
- It was first observed by **Robert Hooke** in cork tissue of oak tree.
- In Mature cell, cell wall contain three layers.

  1) Middle lamellum

  2) Primary wall

  3) Secondary wall
- Algae have cell wall made of cellulose, galactans,mannans and minerals like calcium carbonate
- Cell wall of most of the plants consists of cellulose, hemicellulose,pectins and protiens
- Fungal cell wall made up of chitin

MIDDLE LAMELLUM:

- It is thin amorphous intercellular matrix between two adjacent plant cells that functions as a cement between them.
- It is the **first structure** that is formed from cell plate between the newly formed daughter cells at the time of cytokinesis.
- It is made up of **pectins,(calcium pectate**, and **magnesium pectate)**.

PRIMARY WALL:

- It is laid inner to the middle lamellum.
- It is thin & elastic and capable of growth.

- Growth occurs due to incorporation of materials into inside of primary wall such growth is called **intussusception**.
- Primary wall consists of **microfibrils and gel-like matrix.**
- It is the only wall in meristematic and soft parenchymatous tissue like mesophyll, cortex, pith, fruit etc
- The cell wall and middle lamellae may be traversed by plasodesmata which connect the cytoplasm of neighbouring cells
- Plasmodesmata helps in inter cellular transport between cells

SECONDARY WALL:

- It is found in mature plant cells
- It is laid inner to the primary wall.
- It is formed by external deposition of new materials over the existing structure. Such growth is called **accretion**.(Apposition)
- New wall materials like **lignin**, **suberin**, **pectin** and **cutin** deposited into cellulose interfibrillar spaces.
- Secondary wall is laid in layers. Usually 3 layers, namely S_1, S_2, and S_3.
- The thickening is of purely cellulose in Collenchyma cells, Cotton Fibres and flax fibres.
- **Suberin** is deposited in the walls of **cork cells.**
- The impregnation is of lignin in the wood(xylem) elements like vessels, tracheids and sclerenchyma, fibres.
- In Xylem, the secondary wall exhibits unthickened areas called **pits** to support intercellular transport.
- **Function of cell Wall** : The Cell wall performs the following important functions :
  - i) It provides a definite shape, protection and mechanical support to the cell.
  - ii) It functions as apoplast.
  - iii) It forms a skeletal framework of plants and provide mechanical support
  - iv) Its depositions like cutin, and suberin reduce transpiration
  - v) It is involved in the movements of metabolites in and out of the cell through plasmodesmata
  - vi) It counteracts the turgor pressure.

ENDOMEMBRANE SYSTEM:

- The functioning of certain membrane bound cytoplasmic organelles is well coordinated.
- They exchange materials among themselves by means of vesicles.
- The Endomembrane system includes
  - Endoplasmic reticulum
  - Golgi complex
  - Lysosomes and
  - Vacuoles
- Functioning of Mitochondria, Chloroplast and Peroxisomes are not coordinated. These are not considered as part of the endomembrane system.

ENDOPLASMIC RETICULUM (ER):

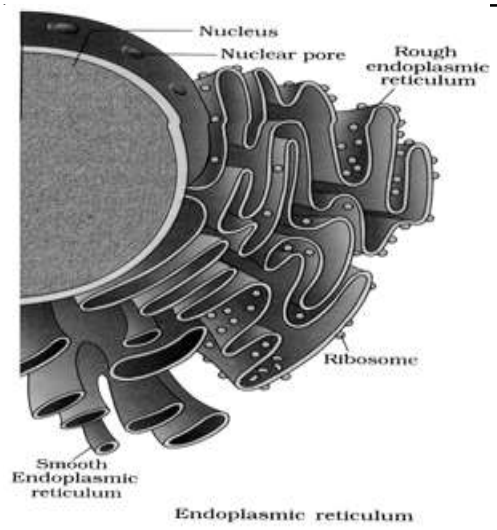
- The term ER is coined by **K.R.Porter**.
- It is found in all eukaryotic cells except mature erythrocytes.
- It is a complex membrane lined network of flattened sacs, tubules and vesicles that runs throughout the cytoplasm of eukaryotic cells from plasma membrane to nuclear envelope.
- Prokaryotic cells do not possess E.R.
- Endoplasmic reticulum constitutes 30-60% of the total endomembrane system.
- It divides the intercellular space into compartments, **luminal** and **extra luminal**

Types of ER:

- It is of two main types
  1) Smooth ER/Agranular ER
  2) Rough ER/Granular ER

1) Smooth Endoplasmic Reticulum(SER):

- Its membranes are smooth. They are devoid of ribosomes.
- It is more abundant near the plasmalemma with which it may be attached.
- SER is believed to be formed from RER.
- It contains few cisternae, concentration of tubules and vesicles is higher.
- **SER is the major** site for **synthesis of lipid**.
- In animal cells, **lipid** like **steroidal hormones** are synthesized in SER.



Endoplasmic reticulum

2) Rough Endoplasmic Reticulum(RER):

- Their surface contain large number of ribosomes.
- RER has more of cisternae and fewer number of tubules and vesicles.
- It is more abundant near the nucleus where it is connected with its outer membrane.
- It is specialised to synthesise and transport proteins. Therefore it occurs in cells engaged in active metabolism, secretion of proteins and enzymes.

GOLGI APPARATUS:

- **Camillo Golgi** first observed densely stained reticular structures near the nucleus.
- These are later named as **Golgi bodies**.
- They consists of many flat, disc-shaped sacs or cisternae of 0.5µm to 1.0µm diameter.
- These are stacked (6-8) parallel to each other.
- Independent subunits are called **dictysomes.**
- Curvature gives a polarity to cisternae.
- Cisternae are generally arranged concentrically near the nucleus. There is a proximal convex formative **cisface** and a distal concave maturation **trans-face**.
- The concave maturation face is towards the plasmalemma.
- The number of cisternae is counted from the **forming face**.
- Membrane of the cisternae thickness increases from forming face to **maturation face.**

Golgi apparatus

FUNCTIONS OF GOLGI APPARATUS

i) The main function of Golgi apparatus is to process, package, transport and release of secretory proteins

ii) Golgi apparatus is in close association with E.R

iii) Materials to be packaged in the form of vesicles from the E.R, fuse with the cis face of golgi apparatus and moves towards the maturing face.

iv) They cause glycosidation of lipids and glycosidation of proteins to form glycolipids and glycoproteins

v) Most of the proteins synthesised at ER are modified in Golgi bodies

LYSOSOMES

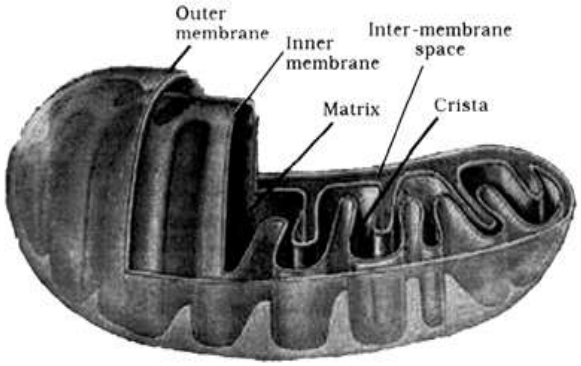
- These are **single membrane bound** vesicular structures formed by the process of packaging in the golgi apparatus.
- The isolated lysosomal vesicles are rich in **hydrolytic enzymes.**
- **Christian De Duve** named lysosomes.
- They are cytoplasmic organelles of eukaryotic cells.
- They have also been reported in f**ungi, seeds, root tips, etc.**
- Lysosomes are very rich in hydrolytic enzymes (hydrolases) capable of digesting carbohydrates (carbohydrases), proteins(proteases), lipids (lipases) and nucleic acids(nucleases)
- Digestive enzymes present in lysosomes are called **acid hydrolases** as they function at **acidic p^{H}**..
- Under starvation conditions, lysosomes digest cellular contents by realeasing hydrolyzing enzymes and cause death of cell. This is called **autolysis**.

VACUOLE:

- It is the membrane-bound space found in the cytoplasm.
- It contains sap tonoplasm mainly composed of water, metabolic bye products, excretions and other waste materials.
- In some plant cells, vacuolar sap also contains some pigments like **anthocyanin** which impart colour to the plant part.
- The vacuole is bound by a single membrane called **tonoplast**.
- In plant cells the vacuoles can occupy upto 90% of the volume of the cell and play important role in **osmoregulation.**
- In plants, the tonoplast facilitates the transport of a number of ions and other materials against concentration gradients into the vacuole.
- Hence their concentration is significantly higher in the vacuole than in the cytoplasm.
- In Meristematic cells **many small vacuoles** are present.
- In Mature cells a single large vacuole with peripheral cytoplasm. This condition is called **Primordial Utricle**.
- In Amoeba and algal cells the contractile vacuole is important for excretion and **osmoregulation**
- In many cells as in protists, food vacuoles are formed by engulfing the food particles.They contain digestive enzymes
- **Gas vacuoles** occur in prokaryotes.
- Gas vacuoles store metabolic gases, provide mechanical strength, regulate buoyancy and dilute the intensity of harmful radiations.

MITOCHONDRIA:

- In Greek language **Mitos - thread,Chondrion - grain.**
- The number of mitochondria per cell is variable depending on the physiological activity of the cells.
- Dormant and inactive cells possess fewer mitochondria.
- In animal cells, mitochondria are the second largest cell organelles.
- In plant cells they have the third largest size.
- Commonly mitochondria are 0.2-1.0μm in diameter(average 0.5μm) and length 1.0-4.1μm.
- Typically it is sausage - shaped or cylindrical.
- It is spherical in **yeast**.
- Each mitochondrion is covered by a double membrane envelope which encloses a highly involuted inner core or inner chamber.
- There is an outer and an inner membrane in the envelope.
- Inner membrane dividing its lumen distinctly into two aqueous compartments, i.e. the outer compartment (cytosol or C-face) the inner compartment (matrix or M-face).
- The outer membrane forms the continuous limiting boundary of the organelle.
- The inner membrane forms a number of infoldings called the **cristae** towards the matrix.
- The cristae increase the surface area of inner membrane.
- On cristae stalked particles called **oxysomes**, **Racker's particles**, **F_0-F_1 particles** or **elementary particles** are present.
- The matrix also possesses single circular DNA molecule,(with high G ≡ C ratio) a few RNA molecules, (all 3 forms of RNA) 70s-ribosomes and the components required for the synthesis of proteins.
- During aerobic respiration they produce cellular energy in the form of ATP, hence they are called **Power houses of the cell**.
- The mitochondria divide by **fission**



PLASTIDS:

- **E. Haeckel** (1865) gave the term plastid. Plastids are largest cell organelles.
- Plastids are double membrane covered cytoplasmic organelles that possess their own genetic machinery.
- They take part in storing or synthesising organic compounds.
- They occur in plants and euglenoids.
- Plastid precursors are called **Proplastids**.

Proplastids → Leucoplasts € Chloroplasts
Proplastids → Chloroplasts € Chromoplasts
Proplastids → Chromoplasts € Chloroplasts

PROPLASTIDS:

- They are colourless, rounded but amoeboid plastid precursors found in meristematic and newly formed plant cells.
- It has a double membrane envelope that surrounds a colourless matrix.
- The matrix contains **DNA, Ribosomes** and **reserve food**.
- A few vesicles and lamellae also occur in the matrix.
- They develops from inner membrane.
- Based on the type of pigments plastids can be classified into **leucoplast,chromoplast** and **chloroplasts**.

LEUCOPLASTS:

- Leucoplasts are colourless plastids that occur in non green plant cells, commonly near the nucleus.
- They contain lamellae, some of which are found to be connected with inner membrane.
- Lamellae are not organised to form grana.
- **Photosynthetic pigments are absent.**
- Many leucoplasts become specialised to store food materials.
- These are of 3 types.

(i) Amyloplasts:

Starch storing leucoplast is called **amyloplast**.
Eg: tuber of potato, grain of rice and wheat.

(ii) Elaioplasts:

-They store oils and fat.
Eg: Endosperm of caster seed

(iii) Aleuroplast:

-They are protein storing leucoplasts.
Eg: Aleurone layer of Maize grain, cotyledons of Pulses

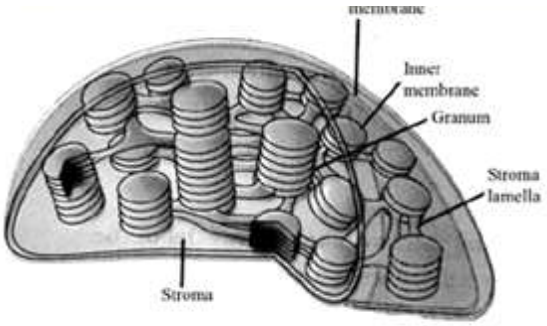
CHROMOPLAST:

- They are non-photosynthetic coloured plastids which synthesise and store carotenoid pigments.
- They contain fat soluble carotenoid pigments like **carotene, xanthophylls**.
- They, therefore appear orange red or yellow in colours.
- They develop from **proplastids, leucoplasts and chloroplasts.**
- Transformation from chloroplasts is observed during ripening of fruits due to loss of chlorophyll. Eg: Tomato, Chilly
- The most common carotenoid of these fruits is **lycopene**.
- Tuberous roots of carrot contain **carotene**.
- Coloured flowers contain chromoplast. And such flowers attract pollinating insects.
- The coloured fruits attract birds for dispersal.
- Certain carotenoids form Abscisic acid and later they closes stomata and induces dormancy.

CHLOROPLAST:

- They are green or chlorophyll containing plastids of plant cells and some protists(Euglena) which are specialised to perform photosynthesis or synthesis of organic food from inorganic raw materials with the help of energy obtained from solar radiations.
- Majority of the chloroplasts of the green plants are found in the **mesophyll cells** of the leaves.
- Chloroplasts of green plants are generally **disc-shaped** with **circular (or) oval-elliptical outline.**

Shape of Chloroplast	Plant Name
Collar - like	Ulothrix
Ribbon - shaped	Spirogyra
Cup - shaped	Chlamydomonas
Stellate	Zygnema
Reticulate	Oedogonium



Sectional view of chloroplast

SECTIONAL VIEW OF CHLOROPLAST

- Chloroplasts are the second largest cell organelles of plant cells with a length of 5-10µm and width 2-4µm.
- Their number varies from plant to plant. Eg: -A single chloroplast is present in the cells of ***Chlamydomonas.***
- A chlorenchyma cell of leaf possesses 20-40 chloroplasts in peripheral cytoplasm.
- Like mitochondria, chloroplasts are also double membrane bound.
- Of the two, the inner membrane of chloroplast is relatively less permeable.
- The space limited by the inner membrane of the chloroplast is called **stroma**.
- A number of organised flattened membranous sacs called **thylakoids**, are present in the stroma.
- Thylakoids are arranged in stacks like the piles of coins called **grana** or the intergranal thylakoids.
- In addition, there are flat membranous tubules called the stroma lamellae connecting the thylakoids of different grana.
- The membrane of the thylakoids enclosed a space called a **lumen**.
- The stroma of the chloroplast contains enzymes required for the synthesis of carbohydrates and proteins. It also contains a small, double-stranded, circular DNA molecules, mRNA, rRNA, tRNA and 70s ribosomes.
- Photosynthetic pigments are present in the thylakoids.
- Thylakoid membranes possess chlorophylls (a and b in plant chloroplast), Carotenoids (carotenes and xanthophylls).
- The ribosomes of the chloroplasts are smaller (prokaryotic, 70s) than the cytoplasmic ribosomes (Eukaryotic, 80s).
- **Functions :** The chloroplasts perform various functions like;

  i) Photosynthesis - light reaction (in thylakoids), Dark reaction (in stroma)

  The main function of chloroplast is photosynthesis, in which radiant energy of sun is converted into chemical form of energy, which is ultized by all living organisms to perform their life activities. Further, **chloroplasts** help in maintaining **balance of O_2 and CO_2** in the atmosphere

  2) Storage of Strach
- These different types of plastids are interchangeable e.g., In tomato

  Young ovary (colourless) $\rightarrow$ Leucoplasts

  Young fruits (green) $\rightarrow$ Chloroplasts

  Mature fruits (red) $\rightarrow$ Chromoplasts

  In carrot root : Leucoplast $\rightarrow$ Chromoplast

  In chilly : Chloroplast $\rightarrow$ Chromoplast

SIMILARITIES BETWEEN MITOCHONDRIA & CHLOROPLASTS

1. **Origin.** Both are formed by division of pre-existing organelles.
2. **Envelope.** They are covered by a double membrane envelope.
3. **Outer Membrane.** It is smooth and permeable to many solutes as well as metabolites.
4. **Inner Membrane.** The membrane is selectively permeable in both.
5. **Infoldings.** Inner membrane develops involutions, cristae in mitochondria and lamellae in chloroplasts.
6. **Autonomy.** Both the organelles are semi-autonomous.
7. **Genetic Systems.** They possess their own DNA, RNA and ribosomes.
8. **DNA.** DNA is circular and naked. **chloroplast DNA** is, however, bigger than **mitochondrial**

DNA.

9. **Ribosomes.** Ribosomes present in these organelles are 70s.
10. **Phosphorylation.** Both possess electron transport chains and take part in synthesis of ATP. (photo phosphorylation and oxidative phosphorylation)

RIBOSOMES:

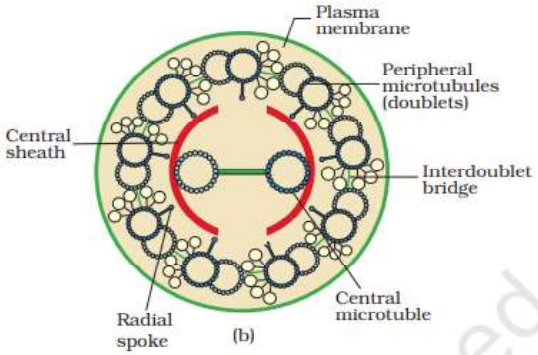
- Ribosomes are composed of **ribonucleic acid** (RNA) and **proteins**, so they called **ribonucleoprotein granules**.
- They are not surrounded by any membrane. These are **smallest organelle**.
- These are found in both prokaryotic and eukaryotic cells and are, therefore, considered to be **universal cell organelle**.
- Eukaryotic cells have two types of ribosomes, cytoplasmic (80s) and organelle (70s).
- Cytoplasmic ribosomes (80s) or cytoribosomes may occur free in the cytosol or bound to endoplasmic retuiculum and outer surface of nuclear envelope.
- Organelle ribosomes (70s) occur in two types of semi-autonomous organelles mitoribosomes in the matrix of mitochondria and stroma of plastids (leucoplast, chloroplast).
- Here 'S' stands for the **sedimentation coefficient**. It is indirectly a measure of density and size.
- Both types of ribosomes are composed of larger and smaller subunits.
- 70s ribosome contains 50s and 30s subunits while 80s contains 60s and 40s subunits.
- The two subunits in both types of ribosomes associate with each other by Magnesium ions.
- Ribosomes provide space as well as enzymes for the synthesis of proteins.
- During protein synthesis, many ribosomes form a chain on a common m - RNA and form the polysomes or ergosome

CYTOSKELETON:

- An elaborate network of filamentous proteinaceous structures present in the cytoplasm is collectively referred to as **cytoskeleton**.
- Eukaryotic cells contain three major components of cytoskeleton:
  (a) Microtubules (b) Microfilaments
  (c) Intermediate filaments
- Cytoskeleton in a cell is involved in many functions such as
  i) Mechanical support
  ii) Maintenance of cell shape
  iii) Cell motility
  iv) Intracellular transport
  v) Signaling across the cell and karyokinesis

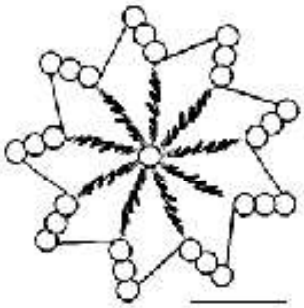
CILIA AND FLAGELLA:

- Cilia and flagella are hair like outgrowths of the cell membrane.
- Cilia are small structures which work like oars, causing the movement of either the cell or the surrounding fluid.
- Flagella are comparatively longer and responsible for cell movement.
- Prokaryotic bacteria also possess flagella but these are structurally different from that of the eukaryotic flagella.
- Both (cilia & flagella) are covered with **plasma membrane**.
- Their core called the **axoneme**, possesses a number of microtubules running parallel to the long axis.
- The axoneme usually has nine pairs of doublets of radially arranged peripheral microtubules and a pair of centrally located **microtubules.**
- Such an arrangement of axonemal microtubules is referred to as the 9+2 array.
- The central tubules are connected by bridges and are also enclosed by a **central sheath,** which is connected to one of the tubules of each peripheral doublet by a **radial spoke.**
- Thus, there are nine radial spokes.
- The peripheral doublets are also interconnected by linkers.
- Both the **cilium** and flagellum emerge from centriole-like structures called the **basal bodies**.



CENTROSOME AND CENTRIOLES:

- These occur in all eukaryotic animal cells and motile lower plant cells
- Centrosome is an organelle usually containing two cylindrical structures called **Centrioles**.
- They are surrounded by amorphous pericentriolar materials. Both the centrioles in a centrosome lie at right angles to each other.
- They are made up of **nine evenly** spaced peripheral **fibrils of tubulin**.
- Each of the peripheral fibril is a triplet. The adjacent triplets are also linked.
- The central part of the centriole is also proteinaceous and called the **hub**; which is connected with tubules of the peripheral triplets by radial spokes made of proteins.



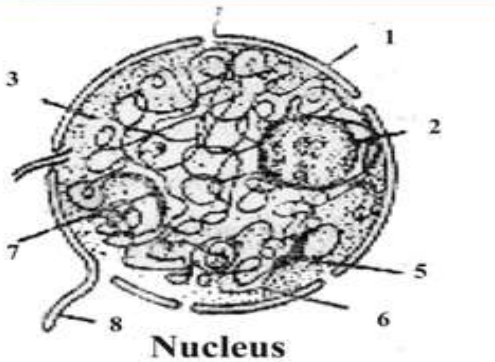
Centriole

FUNCTIONS:

- They polymerize microtubules for formation of spindle fibres and astral rays during mitosis and meiosis.
- Centrioles help in the organisation and development of cilia and flagella
- When centrioles move to periphery of the cell, these function as kinetosomes or basal bodies
- They determine the poles during cell division.

NUCLEUS:

- Nucleus as a cell organelle was first described by **Robert Brown** as early as 1831.
- The material of the nucleus stained by the basic dyes was given the name **chromatin by Flemming.**
- The interphase nucleus (nucleus of a cell when it is not dividing) has highly extended and elaborate nucleoprotein fibres called chromatin, nuclear matrix and one or more spherical bodies called nucleoli (sing:nucleolus).
- Nuclear envelope, consists of two parallel membranes with a space between (10 to 50 nm) called the perinuclear space, forms a barrier between the materials present inside the nucleus and that of the cytoplasm. The outer membrane usually remains continuous with the endoplasmic reticulum and also bears ribosomes on it.



Nucleus

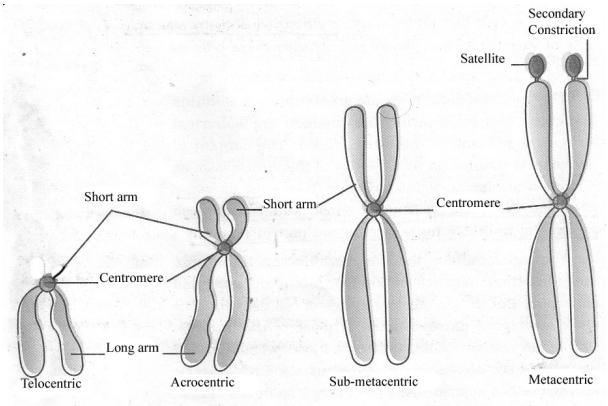
1. Nuclear membrane 2. Nucleolus
3. Nucleoplasm 4. Pores
5. Prochromosome 6. Euchromatin
7. Heterochromatin 8. Endoplasmic reticulum

- At a number of places the nuclear envelope is interrupted by minute pores called **nuclear pores** which are formed by the fusion of its two membranes. These nuclear pores are the passages through which movement of RNA and protein molecules takes place in both directions between the nucleus and the cytoplasm. Normally, there is only one nucleus per cell, variations in the number of nuclei are also frequently observed.
- Some mature cells even **lack nucleus**, e.g., **Erythrocytes** of **many mammals** and **sieve tube cells** of vascular plants.
- The nuclear matrix or the nucleoplasm contains

nucleolus and **chromatin**. The nucleoli are spherical structures present in the nucleoplasm.

- The interphase nucleus has a loose and indistinct network of nucleoprotein fibres called **chromatin**. It is differentiated into two regions
- **Heterochromatin and Euchromatin :**It was observed that when chromosomes are stained with basic dyes like **acetocarmine** or **fuelgen stain**, then two types of regions can be observed:
  - **a) Heterochromatic region :** This region gets dark stain during interphase. This is genetically inactive and highly condensed region with tightly packed DNA
  - **b) Euchromatin region :** This region gets light stain during interphase. This portion is genetically active and rich in loosely packed DNA. Transcription occurs here.

  But during different stages of cell division, cells show structured chromosomes in place of the nucleus.
- Chromatin contains DNA and some basic proteins called **histones**, some **non-histone** proteins and also **RNA.** single human cell has approximately two metre long thread of DNA distributed among its forty six (twenty three pairs) chromosomes.
- Chromosomes were discovered by **Hofmeister** and named by **waldeyer**
- **Structure of Chromosome:** Structurally, a chromosome is composed of following parts :
  1. **Chromatid :**Each metaphase chromosome consists of two symmetrical strands called chromatids.
  2. **Chromonema :** During prophase each chromatid appears to be made of very thin and highly coiled filaments called chromonemata (as subunits of chromatids)
  3. **Chromomeres :** These are bead - like structures formed due to condensation of chromatin material. These are believed to be location of genes.
  4. **Centromere :** The two chromatids are attached to each other by a narrow area, also called primary constriction. This decides the ratio of arm length called **centromeric index**. Two arms may be equal (Isobrachial) or unequal (Heterobrachial).
  5. **Kinetochore :** This is a disc-shaped protein structure attached to the centromeric portion
  6. **Telomere :** This term is applied to the cytologically distinct tips of the chromosomes , these are specific for a chromosome and are rich in G and T bases.
  7. **Nucleolar Organising Region (NOR) :** These areas are certain secondary constrictions containing the genes which code for ribosomal RNA that induce the formation f nucleoli. The chromosomes with these regions are called nucleolar organising chromosomes
  8. **Satellites :** This is a rounded body separated from the rest of the chromosome by a secondary constriction, a chromosome having satellite is called SAT-chromosome and these are considered marker chromosome (SAT-Sine Acid Thymonuclenico)
- Based on the position of the centromere, the chromosomes can be classified into four types.
  - i) The **metacentric chromosome** has middle centromere forming two equal arms of the chromosome. These chromosomes appear 'v'-shaped
  - **ii) The sub-metacentric chromosome has centromere is slightly away from the centre** resulting into one shorter arm and one longer arm. Appear 'L'-shaped
  - iii) In case of **acrocentric chromosome** the centromere is situated close to its end forming one extremely short and one very long arm.These appear 'J'-shaped
  - iv) Whereas the **telocentric chromosome** has a terminal centromere. These appear *'i'*-shaped



- Sometimes a few chromosomes have non-staining secondary constrictions at a constant location. This gives the appearance of small fragment called the **satellite.**
- When viewed under electron microscope, chromatin appears as "beads-on-string". The beads are now known as **"nucleosomes".**
- A typical nucleosome contains **200bp** of DNA double helix wrapped (two turns) around a core of histone octamer having two copies of each of four types of histone proteins - H_2A, H_2B, H_3 and H_4.
- H1 histone molecule lies outside the nucleosome core and seals the two turns of DNA by binding at the point where DNA enters and leaves the core.
- The DNA that continues between two successive nucleosomes is called **linker DNA.**
- The association between negatively charged DNA and positively charged histones allows for meaningful DNA packaging inside the nucleus.
- The beads-on-string structure in chromatin is packaged to form chromatin fibres that are further coiled and condensed to form the chromosomes.

FUNCTIONS OF CHROMOSOMES:

1) Chromosomes are responsible for carrying the genetic information from one generation to another, as genes are located on them
2) Any variation in chromosome (Structural or numerical) will lead to change in the characters of an organism

MICROBODIES:

- These are single membrane bound organelles associated with oxidiation reactions other t h a n those of respiration . These include

A. Peroxisomes

B. Glyoxysomes

A) Peroxisomes : Peroxisomes are spherical, sac - like structures , bounded by a single membrane. Initially these were reported in animals only, but later also discovered in plants. Christian De Duve discovered them for the first time. These were called **peroxisomes,** because these contain 'peroxide - producing enzymes (oxidases) and 'peroxide '-destroying enzymes (catalases)

- Peroxysomes are involved in the catabolism of long chain fatty acids and play important role in the synthesis of phospholipids.
- Peroxisomes are involved in photorespiration and protection of cells form toxic effects of hydrogen peroxide.

b) Glyoxysomes : Glyoxysomes are bounded by a single membrane. These contain enzymes for the glyoxylate cycle through which fats are converted into carbohydrates (gluconeogenesis). These are found in germinating seeds, especially in germinating fatty seeds such as castor seeds.

DIFFERENCES BETWEEN PROKARYOTIC CELL & EUKARYOTIC CELL

S.No.	PROKARYOTIC CELL	EUKARYOTIC CELL
1.	The size is 0.1-5.0µm.	The size is 5-100µm.
2.	The cell possesses one-envelope system.	The cell contains two-envelope system.
3.	Cell wall, if present, contains mucopeptide or peptidoglycan.	Cell wall, if present, contains cellulose. Peptidoglycan is absent.
4.	A typical nucleus is absent. Instead nucleoid or genophore is present.	Eucaryotic cell contains a typical nucleus made of nuclear envelope, chromatin, nucleoplasm, nuclear matrix and nucleoli.
5.	DNA of nucleoid lies freely in the cytoplasm.	DNA lies inside the nucleus, mitochondria and plastids.
6.	DNA is generally circular.	DNA is commonly linear. However, circular DNA does occur inside mitochondria and plastids.
7.	DNA is naked or without any association with histone proteins.	DNA is associated with histones.
8.	DNA content is low.	DNA content is comparatively quite high.
9.	Nucleoid is equal to a single chromosome and is called prochromosome.	Nucleus contains chromatin material of two or more chromosomes.
10	Introns or nonessential intervening sequences are commonly absent in DNA. RNA, therefore, does not require splicing.	Introns are quite common. RNA, therefore, requires splicing before becoming operational.
11.	Plasmids may occur.	Plasmids are rare.
12.	Cell membrane may have infolding called mesosome.	A mesosome like structure is generally absent.
13.	Cell membrane is involved in separating replication products.	Cell membrane does not take part in separating replication products.
14.	A spindle apparatus is not formed during cell division.	A spindle apparatus is formed during cell division.
15.	Flagella are smaller, 4 - 5µm x 12nm.	Flagella are longer, 150-200µm x 200nm.
16.	Flagella are single stranded.	Flagella are 11-stranded.
17.	A distinction of axoneme & sheath is absent in the flagellum.	A flagellum shows distinction of axoneme & sheath.
18.	Cyclosis is absent.	Cytoplasmic streaming or cyclosis is common.
19.	Endocytosis & exocytosis are absent.	They occur in eukaryotic cells.
20.	Sap vacuoles are absent.	Sap vacuoles are quite common.
21.	Gas vacuoles may occur to provide buoyancy & protection against intense radiations.	Gas vacuoles are absent.
22.	Cytoplasm does not possess endoplasmic reticulum.	Endoplasmic reticulum is usually present.
23.	Ribosomes occur freely in the cytoplasm as well as attached to plasmalemma.	Ribosomes occur in cytoplasm as well as two cell organelles (mitochondria and plastids). In cytoplasm the ribosomes are both attached to endoplasmic reticulum as well as free in cytoplasm.
24.	Ribosomes are 70S.	80S ribosomes occur in cytoplasm. Organelle ribosomes are 70S.
25.	Thylakoids, if present, lie freely in the cytoplasm.	Thylakoids occur inside chloroplasts.
26.	Mitochondria are absent.	Mitochondria are often present.
27.	Respiratory enzymes occur attached to plasma membrane.	Respiratory enzymes occur in cytoplasm and mitochondria.
28.	Golgi apparatus is absent.	Golgi apparatus is present.
29.	Lysosomes, sphaerosomes and glyoxysosomes are absent.	They are often present.
30.	Microtubules & microfilaments are rare.	They are usually present.
31.	Centrosome is absent.	Centrosome is present except in flowering plants and a few others.

DIFFERENCES BETWEEN 70S(PROKARYOTIC) AND 80S(EUKARYOTIC) RIBOSOMES

S.No.	70S (PROKARYOTIC) RIBOSOMES	80S (EUKARYOTIC) RIBOSOMES
1.	The Ribosomes are found in prokaryotes, mitochondria and plastids of eukaryotes.	The Ribosomes occur in cytoplasm of eukaryotes.
2.	Sedimentation coefficient is 70S.	Sedimentation coefficient is 80S.
3.	The ribosomes are free.	They are both free and membrane bound.
4.	The size is 20-29nm in length & 17-21nm in breadth.	The size is 30-34nm x 20-24nm.
5.	Weight is 2.7-3.0 million daltons.	It is 4.0-4.5 million daltons.
6.	The smaller and larger subunits are respectively 30S and 50S.	The two subunits are 40S and 60S.
7.	RNA to protein ratio is 60-65:35-40.	RNA to protein ratio is 40-44:56-60.
8.	Number of protein molecules is 21 in smaller subunit and 34 in larger subunit.	Number of protein molecules is 30 in smaller subunit and 40 in larger subunit.
9.	rRNAs are 16S in smaller subunit, and 23S+5S in larger subunit.	rRNAs are 18S in smaller subunit, and 28S+5.8S+5S in larger subunit.
10.	All the rRNA are transcribed nearby.	18S, 5.8S, 28S rRNAs are transcribed in the region of nucleolus while 5S rRNA is synthesized away from it.
11.	Ribosomes synthesis occurs in cytoplasm of prokaryotes and matrix of mitochondria as well as plastids.	Ribosome synthesis occurs in the nucleolus.
12.	Protein synthesis is inhibited by chloramphenicol but not by cycloheximide.	Protein synthesis is inhibited by cycloheximide but not chloramphenicol.

DIFFERENCES BETWEEN OUTER AND INNER MITOCHONDRIAL MEMBRANE

S.No.	*OUTER MITOCHONDRIAL MEMBRANE*	*INNER MITOCHONDRIAL MEMBRANE*
1.	It is smooth. Cristae are absent.	The inner mitochondrial membrane is folded to form a number of ingrowths called cristae.
2.	The membrane is permeable to a large solutes.	It is selectively permeable to even small number of solutes & metabolites.
3.	Protein content is about 60%.	Protein content is about 80%.
4.	Lipid content is high, about 40%.	Lipid content is low, about 20%.
5.	Phospholipid & cholesterol contents are high.	Phospholipid & cholesterol contents are 1/3-1/6 of the outer membrane.
6.	Cardiolipins are scarce.	Cardiolipins are abundant.
7.	The membrane contains porins.	Porins are absent. Instead a number of carriers occur in the membrane.
8.	It does not possess elementary particles.	Elementary particles are present.
9.	Enzymes present in the membrane are not involved in oxidative phosphorylation.	It possesses enzymes connected with electron transport & oxidative phosphorylation.

DIFFERENCES BETWEEN LEUCOPLASTS AND CHROMOPLASTS

S.No.	*LEUCOPLASTS*	*CHROMOPLASTS*
1.	They are colourless plastids.	Chromoplasts are brownish to red in colour.
2.	Leucoplasts have cylindrical to rounded in shape.	They are commonly irregular in shape.
3.	Lamellae are often present.	Lamellar structure degenerates during maturation of chromoplasts.
4.	Leucoplasts commonly occur in the cells of unexposed plant parts.	Chromoplasts commonly occur in exposed parts, except carrot root.
5.	Depending upon stored materials, leucoplasts are of three – amyloplasts, elaioplasts and aleuroplasts.	Chromoplasts are of one type. They may synthesise & store lipids.
6.	Leucoplasts can change into other types of plastids.	Chromoplasts are unable to change into other types of plastids.

DIFFERENCES BETWEEN MITOCHONDRIA AND CHROMOPLASTS

S.No.	*MITOCHONDRIA*	*CHLOROPLASTS*
1.	Mitochondria are colourless cell organelles.	They are green cell organelles.
2.	They occur in plants, animals, fungi and protists.	Chloroplasts occur in plants and some protists.
3.	The organelles are found in all cells of aerobic organisms.	They are present in only green cells exposed to light.
4.	Mitochondria are generally cylindrical in outline.	Chloroplasts of higher plants are discoid in outline. They have various shapes in lower organisms.
5.	The inner membrane shows involutions called cristae.	The inner membrane develops involutions called lamellae or thylakoids.
6.	Cristae remain attached to inner membrane.	Thylakoids generally separate from the inner membrane.
7.	Intracristal space is connected to outer chamber.	Intrathylakoid space or loculus is not connected to periplastidial space.
8.	There is no stacking of cristae.	Thylakoids are stacked at places to produce grana.
9.	Mitochondria lack pigments.	Chloroplasts possess photosynthetic pigments.
10.	ATP-ase synthetase projects towards the inner surface of cristae.	ATP-synthetase projects towards the outer surface of thylakoids.
11.	They undertake catabolic reactions.	Chloroplasts perform anabolic reactions.
12.	There is no mechanism to harvest light energy.	They are able to harvest light energy & convert into chemical energy.
13.	Mitochondria perform part of respiration.	Chloroplasts perform all the steps of photosynthesis.
14.	Organic food is broken down to produce energy.	Organic food is built up to store energy.
15.	They consume oxygen.	They liberate oxygen.
16.	Mitochondria produces CO_2 and H_2O as end products.	Chloroplasts utilize CO_2 and H_2O as raw materials.

DIFFERENCES BETWEEN CILIA AND FLAGELLA

S.No.	*CILIA*	*FLAGELLA*
1.	A cell bears many cilia, 300-14000.	A cell bears few flagella, 1-4.
2.	The length is 2-10µm.	The length is 100-150µm.
3.	Cilia occur throughout or on major part of the cell surface.	Flagella develop from one end of the cell.
4.	There is coordination in beating of different cilia of the same cell.	Flagella show independent beating.
5.	Ciliary beating is asymmetrical.	Flagellar beating is symmetrical.
6.	Cilia perform sweeping or rowing action.	Flagella perform undulatory action.
7.	Besides locomotion, cilia can perform function of circulation, aeration, protection, feeding, etc.	Flagella take part in locomotion only.
8.	They may form cirri and undulating membrane.	Such groupings and fusions are unknown in flagella.

MODEL TEST - I

1. Who observed few living cells capable of moving, such as bacteria, protozoa, spermatozoa and red blood corpuscles under his own designed microscope?
   1) Aristotle 2) Robert Hooke
   3) Leeuwenhoek 4) Dutrochet
2. Cells that have membrane bound nucleus are found in
   1) Rhizobium 2) Meristem
   3) Sieve tube 4) Nostoc
3. Endomembrane system of cell includes
   1) Golgi complex
   2) Lysosome and vacuoles
   3) ER 4) All of these
4. Intercellular matrix or common layer between the primary walls of adjacent cells is
   1) Middle lamella 2) Primary wall
   3) Secondary wall 4) Periplasmic space
5. Which structure determines the shape of the cell and provides a strong structural support to prevent the bacterium from bursting?
   1) Slime layer 2) Capsule
   3) Cell membrane 4) Cell wall
6. The semifluid nature of the biomembrane
   1) Helps in quick repair
   2) Provides dynamic nature
   3) Gives semipermeable nature
   4) More than one option is correct
7. Which face of golgi complex rise to the secretory vesicles?
   1) Trans face 2) Proximal face
   3) Convex face 4) Cis face
8. A forming face and maturing face are seen in this cell organelle
   1) Golgi complex 2) Endoplsmic reticulum
   3) Chloroplast 4) Mitochondria
9. RER is found abundantly in those cells which are actively involved in
   1) Protein synthesis 2) Lipid synthesis
   3) Steroidal hormones synthesis
   4) Glycogen metabolism
10. This is not a function of the cell organelle which was named by Porter
    1) Protein synthesis
    2) Synthesis of cell wall materials
    3) Lipid synthesis
    4) Synthesis of steroidal hormones

MODEL TEST - II

11. Which of the following is not true of a eukaryotic cell ?
    1) It has 80S type of ribosome present in the mitochondria
    2) It has 80S type of ribosome present in the cytoplasm
    3) Mitochondria contain circular DNA
    4) Membrane bound organelles are present
12. Plastid differs from mitochondria on the basis of one of the following features. Mark the right answer
    1) Presence of two layers of membrane
    2) Presence of ribosome
    3) Presence of chlorophyll
    4) Presence of DNA
13. Many ribosomes may associate with one mRNA to form
    1) Polyhedral bodies 2) Polysome
    3) Nucleosome 4) Plastidome
14. The power house of the cells has
    1) DNA 2) RNA
    3) Ribosomes 4) All the above
15. Which one of the following plastid is involved in storage of proteins in maize?
    1) Chromoplast 2) Chloroplast
    3) Amyloplast 4) Aleuroplast
16. Which one of the following funtion is not associated with microtubules?
    1) Help in anaphasic movement of chromosomes
    2) Form the cytoskeleton of cilia and flagella

3) Help in pseudopodia formation
4) Spindle and astral ray formation

17. Centrioles have
1) 9+2 arrangement of microtubules
2) 9 peripheral doublet microtubules
3) 2 centrally located microtubules
4) An organisation like the cart wheel

18. One centrosome contains ____ centrioles
1) one 2) two
3) three 4) many

19. Which of the following cell organelles is concerned with photophosphorylation?
1) Mitochondria 2) Plastochondria
3) Chloroplast
4) More than one option is correct

20. The interdoublet links in eukaryotic flagellum are made up of a protein called.
1) Nexin 2) Dynein 3) Flagellin 4) Actin

MODEL TEST - III

21. Cell organelle with both oxidase and catalase enzymes is
1) Lysosome 2) Peroxisome
3) Mitochondria 4) Sphaerosome

22. Karyotheca or nuclear membrane is absent in
1) Nostoc 2) Rhizobium
3) Drosophila 4) Both (1) & (2)

23. This part of nucelus is in contact with endoplasmic reticulum
1) Pore 2) Inner membrane
3) Outer membrane 4) Chromatin

24. Single human cell is with ___ number of chromosomes
1) 23 pairs 2) 46 pairs
3) 23 4) 22 pairs

25. Chromosome with two arms can be seen in chromosome
1) Metacentric 2) Sub-metacentric
3) Acrocentric 4) All the above

26. Lightly stained region of chromatin during interphase is
1) Genetically inactive
2) Highly condensed region
3) Rich in loosely packed DNA
4) Rich in tightly packed DNA

27. Kinetochore is associated with
1) Primary constriction
2) Secondary constriction
3) Satelite
4) More than one option is correct

28. Centromere is also known as
1)Satilite
2) Primary constriction
3) Kinotochore
4)Secondary constriction

29. The position of Secondary constriction is
1)near centromere 2) at tip
3) constant 4) variable

30. Type of histone proteins present in chromatin are
1)4 2) 5 3) 8 4) 9

QUESTION BANK
TYPE - I

31. The middle lamella is composed of
1) Pectates 2) Cellulose
3) Lignin 4) Proteins

32. Cell wall is present in
1) Plant cells 2) Prokaryotic cell
3) Algal cell 4) All the above

33. Plasma membrane is
1) Selectively permeable 2) Permeable
3) Impermeable 4) Partial permeable

34. Selective permeability occurs in
1) Cell wall 2) Plasma membrane
3) Cytoplasm 4) None of these

35. C.Schleiden a German botanist examined a large number of plats and observed
1) All palnts are composed by cells similar in structure and function
2) All palnts contain desimilar cells of different function

3) All palnts are formed by both similar and dissimilar cells.
4) All palnts are formed by different kinds of cells which form the tissue of the palnt.

36. In fluid mosaic model of plasma membrane
1) Upper layer is non-polar & hydrophilic
2) Polar layer is hydrophobic
3) Phospholipids form a bimolecular layer in middle part
4) Proteins form a middle layer

37. Plasmodesmata connections help in
1) Cytoplasmic streaming
2) Synchronous mitotic divisions
3) Locomotion of unicellular organisms
4) Movement of substances between cells

38. Which one of the following is not a constituent of cell membrane?
1) Cholesterol 2) Glycolipids
3) Proline 4) Phospholipids

39. Cell theory as proposed by schleiden and schwann explains
1) All living organisms are composed of cells and products of cell
2) All cell arise from pre-existing cells
3) Cell is the structural and functional unit of all organisms
4) Both 1 and 3

40. Three morphological forms of golgi complex are
1) Lamellae, tubules & vesicles
2) Cisternae, tubules & vesicles
3) Cisternae, tubules & lamellae
4) Granum, thalykoids & vesicles

41. Semi autonomous cell organelles of cell are
1) Nucleus & chloroplast
2) Chloroplast & mitochondria
3) Vacuoles & golgi complex
4) Ribosome & lysosome

42. Cristae are found in
1) Surface of grana
2) Surface of plasma membrane
3) Wall of Mitochondria
4) Nuclear membrane

43. A single unit membrane organelle is
1) Ribosomes 2) Mitochondria
3) Chloroplast 4) Lysosomes

44. Which of the following plastids are helpful in starch formation and storage?
1) Chromoplast 2) Leucoplasts
3) Chloroplast 4) Lycopene

45. Lamellae of chloroplast are known as
1) Granum 2) Frets
3) Thylakoids 4) Stroma lamellae

46. 70S type of ribosomes is found in
1) Prokaryotic cells
2) Prokaryotic cells, chloroplasts & mitochondria
3) Mitochondria
4) Nucleus, mitochondria

47. Grana & stroma lamellae are the parts of
1) Mitochondria
2) Chloroplast
3) Endoplasmic reticulum
4) Vacuoles

48. The main area of cellular activities in plant and animal cell is
1)Cytoplasm 2) Nucleus
3)Nuceolus 4) Chromosomes

49. Which of the following substances are stored in Aleuroplast
1) Starch 2) Oil & Lipids
3) Proteins 4) Water & Oil

50. Smallest cell organelle which is called protein factory is
1) Ribosome 2) Lysosome
3) Vacuoles 4) Endoplasmic reticulum

51. The Ribosomes are made up of
1) DNA+Protein 2) RNA+Protein
3) DNA+RNA 4)None of these

52. Cilia and flagella both have
1) 9+2 arrangement of microtubule
2) Protective structure of cells
3) Only present in protozoa animals
4) Only outgrowth structure of cytoplasm

53. Centrioles & centrosomes are present in cells of
1) Animals 2) Bacteria
3) Green cells 4) Cyanobacteria

54. Double membrane bound bodies in eukaryotic cell are
1Mitochondria,plastids,nucleus
2)Peroxisomes,Glyoxysomes
3)E.R,Golgi complex
4) Lysosomes and vacuoles

55. Eukaryotic cell differ from Prokaryotic cell in having
1) membrane bound organelles
2) membrane bound Nucleus
3) Both 1 and 2
4) dense matrix of cytoplasm

56. Which of the following pair lack the unit membrane?
1) Nucleus & E.R.
2) Mitochondria & chloroplast
3) Ribosome & nucleolus
4) Golgi body & lysosome

57. Golgi body is concerned with
1) Respiration 2) Secretion
3) Excretion 4) Degradation

58. The cell organelles commonly present in both prokaryotes and eukaryotes
1) Peroxisomes 2) Lysosomes
3) Ribosomes 4) Nucleolus

59. Within the cells ribosomes are found in
1) Chroroplast, Mitochondria,Rough E.R
2) Rough E.R microbodies
3) Chroroplast,golgi complex
4) Mitochondria,and Lysosomes

60. Chromosome with centromere at one end
1) Metacentric 2) Sub-metacentric
3) Telocentric 4) Acrocentric

61. The cell organelle in animal cell that helps in cell division
1) Ribosomes 2) Centrioles
3) Nucleus 4) Lysosomes

62. One genome is which type of set of chromosomes
1) Haploid 2) Diploid
3) Triploid 4) Polyploid

63. Which structure is present in chromosomes
1) Nucleus 2) Centromere
3) Centrosome 4) Golgi body

64. Part of chromosome which joins with spindle fibres is
1) Chromatid 2) Chromonema
3) Chromomere 4) Centromere

65. Choose the correct statement
1) All cells are structurally similar and functionally dissimilar
2) All cells are Functionally similar through they differ in size and shape
3) All cells are structurally similar and functionally similar
4) All cells differ gradually in size, shape and activities

66. Plant with minimum number of chromosomes is
1) *Haplopappus gracilis*
2) *Salix tetrasperma*
3) *Poa* 4) *Cynodon*

67. Number of base pairs present in DNA wrapped around a core of histone proteins
1) 146 2) 154 3) 200 4) 54

68. In group like bacteria, blue green algae,mycoplasma and PPLO(pleuro pneumonia like organisms) the cell representation expalins as they are
1) Eukaryotic cell 2) Prokaryotic cell
3) Eukaryotic cell without membrane bound cell organelles
4) Eukaryotic cells that lack macro bodies

69. Cilia and flagella arise from
1) Basal bodies 2) Basal granules
3) Blepharoplasts 4) All of the above

70. Choose the correct statement
1) All prokaryotes have cell wall surrounding cell membrane
2) All prokaryotes lacks membrane bound cell organelles
3) Prokaryotes are identifed by membrane bound nucleus
4) Chromatin material with histone proteins seen in prokaryotes

71. What is the site of enzyme synthesis in cells
1) Golgi body 2) Ribosome
3) Lysosomes 4) Smooth endoplasmic reticulum

72. In prokaryotes in addition to the genomic DNA small circular DNA are present outside these structures are called as
1) Plasmids 2) Nucleoid
3) Chromosomes 4) Mesosomes

73. Glycosidation of lipids and proteins occurs in the cell organelle called
1) Golgi complex 2) Mitochondria
3) Ribosomes 4) Peroxisomes

74. Which of the following cell organelles is justposed to nucleus and contains cisternae
1) Lysosomes 2) Mitochondria
3) Peroxisomes 4) Golgi apparatus

75. Oxidation of $NADH+H^+$ to NAD^+ occurs in
1) F_1 particles of mitochondria
2) Mitochondrial matrix
3) Outer membrane of mitochondria
4) shuttle mechanism of mitochondria

76. The term 'suicide bag' is applicable to cell organelle
1) Golgi apparatus 2) Lysosome
3) Microsome 4) Peroxisome

77. Certain unique phenotypic characters to bacteria are indicated by
1) Nucleoid 2) Chromosomes
3) Genomic DNA 4) Plasmid DNA

78. In bacteria this structure confers resistance to antibiotics
1) Circular DNA 2) Plasmid DNA
3) Genomic DNA 4) Both 2 and 3

79. Identify the example of plant in which chloroplast transform into chromoplast
1) Fruits of Tomato and Chillies
2) Lady finger 3) Cucurbita
4) Cotton

80. Bacteria can be classified into two groups on the basis of
1) Differences in the chemical composition of cell wall
2) Staining reaction 3) Mode of nutrition
4) Both 1 and 2

81. Smooth endoplasmic reticulum is well-developed in the cells, which synthesize
1) Steroids 2) Proteins
3) Carbohydrates 4) All of these

82. A piece of chromatin with 40 H_4 proteins means it contains ___ number of nucleosomes
1) 5 2) 10 3) 40 4) 20

83. More ribosomes would be found in
1) Parenchymatous cells 2) Dead cells
3) Meristematic cells 4) Lignified cells

84. The Golgi complex plays major role
1) As energy transducing organelles
2) In digesting proteins and carbohydrates
3) In trapping light quanta and transforming them into chemical energy
4) In glycosidation of lipids and proteins to produce glycolipids and glycoproteins

85. When will green tomatoes turn red
1) New chloroplasts are made
2) Chloroplasts are disintegrated and converted into chromoplasts
3) Carbon asimilation will not occur
4) Respiration will not take place

86. If the ribosomes of a cell are destroyed then
1) Fats will not stored
2) Proteins will not be formed
3) Carbon assimilation will not occur
4) Respiration will not take place

87. A feature common to nucleus, chloroplast and mitochondria is at the presence of
1) Lamellae 2) Cristae
3) Nucleic acids 4) All the above

88. In the plasmalemma, the hydrophobic tails of the lipid molecules are present towards the inner part to protect then from
1) Toxins 2) Aqueous environment
3) Heat 4) All of the them

89. A carrier protein is required for the transport of theme ions across the membrane
1) Polar molecules 2) Non-polar molecules
3) Nuetral solutes 4) All of them

90. Most of the hydrolytic enzymes of lysosomes function at
1) Basic pH 2) Any pH

3) Neutral pH 4) Acidic pH

91. Polyribosomes are the aggregation of
1) Ribosomes and rRNA
2) Only rRNA 3) Peroxisomes
4) Several ribosomes held together by a string of mRNA

92. If we separate the cell organelles of a living cell, which part should be alive
1) Endoplasmic reticulum
2) Chloroplast
3) Cell wall 4) Ribosomes

93. Which of the following cell organelles is considered to be rich in catabolic enzymes
1) Lysosomes 2) Golgi bodies
3) Mitochondria 4) Endoplasmic reticulum

94. One of the following statement with respect to primary cell wall is wrong
1) It is seen in a young plant cell
2) It is the first formed between middle lamella and secondary wall
3) It is capable of growth
4) It is present between middle lamellum and secondary wall

95. Which of the following is the smallest cell organelle
1) Mitochondrion 2) Ribosome
3) Chloroplast 4) ER

96. The enzymes for Krebs' cycle in mitochondrion are located
1) On the outer membrane
2) On the inner membrane
3) In perimitochondrial space
4) In mitochondrial matrix

97. The endoplasmic reticulum that is not studded with ribosomes on its surface is the major site for synthesis of
1) Proteins 2) Carbohydrates
3) Lipids 4) All of these

98. The highest number of mitochondria are in
1) Parenchyma cells 2) Sieve tubes
3) Meristematic tissues 4) None of these

99. This is not a function of the cell organelle which was named by porter
1) Proteins 2) Carbohydrates
3) Lipids 4) All of these

100. The cell brain shows extensive and continious tiny tubular structures on its outer membrane which is
1) Endoplasmic reticulum
2) Golgi complex 3) Microtubules
4) Chromatin reticumlum

101. Mitochondria and chloroplasts are concerned with the transfer of cellular energy. Is this statement correct ?
1) Yes, it is correct
2) No, mitochondria are but not chloroplast
3) No, neither of them
4) No, chloroplasts are but not mitochondria

102. Where will you find the description of tiny, regular-shaped honey comb like compartments. They make up the tissue of cork of Spanish oak and other plants
1) Systema Naturae 2) Cell theory
3) Micrographia 4) Scala Naturae

103. The endomembrane cell organelle with distinct cis and trans faces is
1) Endoplasmic reticulum 2) Vacuole
3) Golgi complex 4) Lysosome

104. The biomolecules synthesis by the rough endoplasmic reticulum are modified here before being released
1) Golgi complex 2) Vacuoles
3) Lysosomes 4) Peroxisomes

105. After packing materials golgi apparatus secretes then to the
1) Inside of the cell 2) Outside of the cell
3) Both of them
4) Secretion is not a functin of golgi

106. Cell organelle extract from endosperm of germinating castor beans are
1) Glyoxysomes 2) Peroxisomes
3) Transposons 4) None of these

107. The pigment, which is not found in chloroplast is
1) Carotene 2) Chlorophyll
3) Xanthophyll 4) Anthocyanin

108. The enzymes present in lysosomes belong to

class namely
1) 1 2) 2 3) 3 4) 4

109. As they release hydrolase that digest old and damaged cells, the term suicide bags is aptly used by cell biologists for the
1) Golgi bodies 2) Lysosomes
3) Glyoxysomes 4) Glyoxysomes

110. Which of the following statements is correct
1) Ribosomes do not contain DNA
2) Eukaryotic 80S ribosomes break into 50 S and 30 S
3) Plasmodesmata are found as intercellular junction between animal cells
4) Ribosomes were discovered by Beadle and Tatum

111. Which cell structure, substructure acts as the site of oxidation reduction reaction
1) Glyoxysomes 2) Mitochondrial cristae
3) Lysosomes
4) Coated vesicles in Golgi complex

112. Membrane bound space with cell sap most common to plant cells is
1) Chloroplast 2) Lysosome
3) Vacuole 4) Chromoplast

113. A cell biologist used ultrasonic method to disrupt the cell and found fragments in cell organelle, which served as site of ATP synthesis. These fragments actually are the parts of
1) Mitochondria 2) Lysosomes
3) Liposomes 4) Ribosomes

114. One of these is an important function of vacuole
1) Osmoregulation 2) Starch synthesis
3) Energy production 4) Digestion

115. Mitochondria are called as the power houses of the cell because
1) They produce ATP
2) They release O_2
3) They use CO_2
4) They synthesis proteins

116. Select the false statement
1) Ribosomes and centriole are non-membrane bound organelles of a cell
2) Ribosomes are enveloped by a double membrane
3) Plasmodesmata are the cytoplasmic connections between cells
4) Cell membrane is semipermeable or selectively permeable

117. The cell organelle which has DNA is
1) Endoplasmic reticulum
2) Golgi complex 3) Lysosome
4) Mitochondria

118. Identify the correct pair
1) 70% of cellular proteins –Mitochondrial enzymes
2) Lysosomes –Oxidoreductases
3) Peroxisomes–Hydrolases
4) Ribosomes–Transferases

119. Most living cells acquire unwanted compounds either by absorption from their surroundings or as by products of chemical activities. Cell would die if such compounds accumulated in cytoplasm & nucleus. Hence, mechanisms have evolved to effect their removal. In palnt cells, this is accomplished by developing a system of
1) Membranes such as the endoplasmic reticulum
2) Pores in nuclear wall
3) Vacuoles
4) Semipermeable cell membranes surroundin the cytoplasm

120. Under what conditions do lysosomes cause autolysis
1) Starvation 2) Excess food
3) Injection 4) All the above

121. One of these is a cell organelle common in both monera and protista
1) Ribosome 2) Lysosome
3) Mitochondria 4) Chloroplast

122. The process in the cell that is the source of energy for cellular activities is
1) Photosynthesis 2) Respiration
3) Fermentation 4) All of these

123. Ribosomes present in mitochondria are of this type
1) 70S 2) 80S 3) 30S 4) 60S

124. The cell organelle that is continuous with the outermembrane of the cell brain is
1) Mitochondria 2) Endoplasmic reticulum
3) Golgi complex 4) Lysosome

125. Which of the following is not the function of the golgi apparatus
1) Proteins synthesized by the ribosomes on the endoplasmic reticulum are transferred to the Golgi, where it is accumulated in sacs. These sacs may migrate to the surface of the cell and discharge their contents to the outside
2) The protein filled sacs may be retained within the cells as ribosomes
3) It is the site, where the synthesis of polysaccharides takes place
4) It is the site, where synthesis of lipids takes place

126. Plastids are seen in all plant cells and also in
1) Animals 2) Bacteria
3) Euglenoids 4) All the above

127. Classification of plastids is based on their
1) Size 2) Pigments
3) Motility 4) Nuclei acid

128. The types of plastids present in a genus *Solanam tuberosum are*
1) Chloroplasts 2) Chromoplasts
3) Leucoplasts 4) All the above

129. The fine network of membranes distributed throughout the cytoplasm in a cell is
1) Golgi body 2) Mitochondria
3) ER 4) Lysosomes

130. Autonomic genome system is present in
1) Mitochondria and ribosomes
2) Mitochondria and chloroplast
3) Ribosomes and chloroplast
4) Golgi body and mitochondria

131. The pigment molecules of a chloroplast are located within
1) Its thylakoid membranes
2) The space between the inner and outer membranes
3) The inner membrane 4) Intrathylakoid spaces

132. Number of chloroplasts in a cell of *chlamydomonas are*
1) 20-40 2) One
3) Numerous 4) 5 or 6

133. Double membrane bound cell organelles of cytoplasm are
1) Chloroplast 2) Mitochondrion
3) Chloroplast, Mitochondrion and Nucleus

134. Double membrane bound organelles of protoplasm are
1) Chloroplast 2) Mitochondrion
3) Both 1 and 2
4) Chloroplast, Mitochondrion and Nucleus

135. After packing materials golgi apparatus secretes them to the
1) Inside of the cell 2) Outside of the cell
3) Both 1 and 2
4) Secretion is not a function of golgi

136. The space limited by inner membrane of chloroplast is
1) Stroma 2) Lumen
3) Periplastidial 4) Cavity

137. Choose the correct match
1) Cell organelles–Inactive hydrolytic enzyme
2) Centrosome–Smallest cell
3) Cell drinking–Cilium or flagellum
4) Nucleoid – Prokaryotes

138. Intergranal thylakoid are known as
1) Grana lamella 2) Stroma lamellae
3) Lumen 4) Stroma

139. Continuity of cytoplasm from cell to cell is maintained through cytoplasmic connections in plants called
1) ER 2) Tight junction
3) Gap junction 4) Plasmodesmata

140. Amembranous cell organelles inside chloroplast are
1) Pigments 2) Circular DNA
3) Granum 4) Ribosome

141. The main difference between active and passive transport across cell membrane is that the
1) Passive transport is non-selective
2) Active transport occurs more rapidly than passive transport

3) Passive transport is gradient based, while active transport is energy based against concentration gradient
4) Passive transport is confined to anions, while active transport is for cations only

142. Pigments required for light reaction of photosynthesis are present in
1) Stroma 2) Lumen
3) Ribosome 4) Thylakoids

143. Trans membranes are
1) Glycocalyx 2) Intrinsic proteins
3) Extrinsic protein 4) Tunnel protein

144. Enzymes required for protein synthesis are present in
1) Stroma 2) Lumen
3) Circular DNA 4) Granum

145. Mg^{+} ions play an important role in
1) Association of ribosomal sub units
2) Formation of middle lamella
3) Both 1 and 2
4) Production golgi complex

146. According to fluid mosaic model, plasma membrane consists of
1) Cellulose, hemicellulose
2) Phospholipid, intrinsic protein, extrinsic protein
3) Phospholipid, intrinsic protein
4) Phospholipidm hemicellulose

147. Network of proteinaceous filaments present in cytoplasm is known as
1) Endoplasmic reticulum
2) Cytoplasm 3) Cytoskeleton
4) Cell-organelles

148. What is the difference between DNA of chloroplast and nuclear DNA
1) Single DNA in chloroplast
2) Less number of basis in DNA of chloroplast
3) Absence of histone proteins 4) All of the above

149. Nucleoid is a
1) Single inactive nucleus with double stranded DNA and protein
2) A nucleus without karyotheca with proteins
3) Chromosome associated with proteins
4) Group of chromosomes associated with proteins

150. One of the following is not a part of cytoskeleton
1) Microfilaments 2) Microsomes
3) Microtubules 4) Intermediate filaments

151. Nucleus was discovered by
1) Robert Hooke 2) Robert Brown
3) Robert Dixen 4) Robet Koch

152. One of the most abundant constituent of a cell that has a unique structure is
1) Amino acid 2) Carbohydrate
3) Water 4) Nucleic acid

153. During cell division, movement of chromosomes is cooperated by
1) Cilia 2) Flagella
3) Cytoskeleton 4) Ribosomes

154. Chromosomes with terminal centromeres are known as
1) Telocentric 2) Metacentric
3) Sub metacentric 4) Acrocentric

155. The organelle of plant cell that does not contain functional DNA, is
1) Nucleus 2) Chloroplast
3) Mitochondrion 4) Peroxisome

156. Which one of the following pairs is not correctly matched?
1) Nucleus – Genetic information
2) Cell membrane– Selectively Permeable
3) Golgi complex–Secretion
4) Microtubular organelles – Glycolysis

157. The central core of cilium (or) flagellum is known as
1) Axoneme 2) Microtubule
3) Doublet 4) Triplet

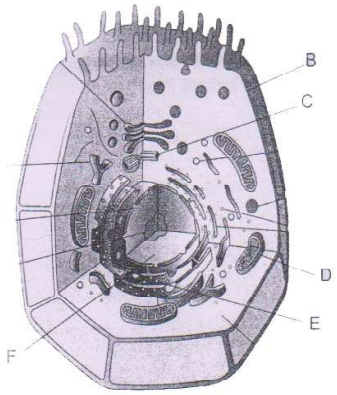
158. Centriole like structure causing the emergence of cilium or flagellum is known as
1) Basal body 2) Hub
3) Axoneme 4) Centrosome

159. Thread like coloured material of eukaryotic nucleus is known as
1) Karyon 2) Nucleolous
3) Chromatin 4) Spoke

160. Tick the wrong statement
1) Mammalian erythrocytes are without nucleus

2) All dead cells are without nucleus
3) Mature sieve tube cells of cryptogams are without nucleus
4) All eukaryotic cells are with nuclear membrane

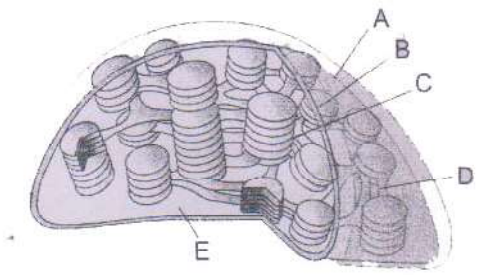
161. Identify the correct statements in the given cell



A. Concerned with lipid and steroidal hormone synthesis
B. Outer non-living rigid structure which gives shape to the cell and protects from mechanical damage and infection
C. Both lie perpendicular to each other and each has an organisation like the cart wheet
D. Responsible for trapping light energy for the synthesis of sugar
E. Present in cells actively involved in protein synthesis and secretion
F. Spherical structures, rich in hydrolytic enzymes

1) A, D & E 2) B, C, D
3) A, C & E 4) A, B, C, F

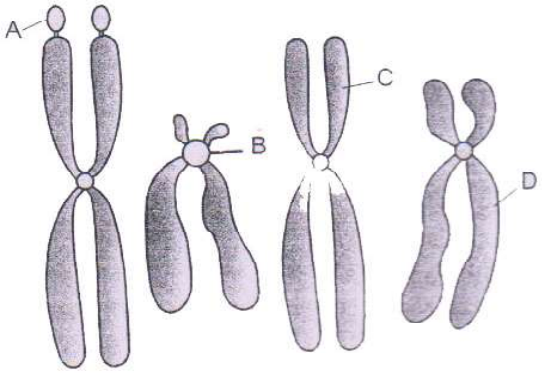
162. Consider the following five statements (A to E)w.r.t chloroplast shown below. select the correct option stating which ones are True (T) and which ones are False (F)



A. It is impermeable and lack porins
B. It is selectively permeable having carrier
C. Stalked thylakoids one over other which is the site of production of assimilatory power
D. Present between two grana and contains enzymes of dark reaction
E. It contains enzymes for the synthesis of sugar and proteins

	A	B	C	D	E
1)	F	T	T	T	T
2)	F	T	T	F	T
3)	T	F	T	T	T
4)	T	F	F	T	T

163. Find out the correct option on the basis of following diagrams



1) A - Satellite, B-Secondary constriction C- Short arm, D- Long arm
2) A - A satellite, B - Centromere, C- Short arm, D- Long arm
3) A - Secondary constriction, B - Satellite C - Long arm, D - Short arm
4) A - NOR, B- secondary constriction C - Short arm, D - Long arm

TYPE - II

164. Prokaryotic cell differes from eukaryotic cell in lacking
I) Nuclear envelope
II) Membrane bound cell organells
III) Nucleolus IV) Histone proteins
1) I, II, III and IV 2) I and II only
3) I, II and III 4) I and III only

165. Regarding prokaryotic cells
I) Absence of nucleus

II) Absence of membrane -bound protoplasm.
III) Compartmentalized nuclear meterial and cytoplasm
IV) Absence of nucleolus
1) I only correct 2) I and II correct
3) II and III only incorrect
4) IV only correct

166. Middle lamellum is
I) The intercellular cement-like substance binding adjacent cells together
II) Made up mainly of calcium pectate and little amout of magnesium pectate
III) Cell plate formed during cytokinesis transforms into middle lamellum
IV) Found in the middle of primary wall and secondary wall
1) I and II are only correct
2) II and III are only correct
3) I, II, III and IV are correct
4) IV alone is incorrect

167. Structures responsible for intracellular transport of materials
I) E.R II) Glogi complex
III) Peroxisomes IV) Cytoskeleton
1) I and II are correct 2) II and III are correct
3) III and I are correct 4) I and IV are correct

168. Study the following statements. The correct statements are
I) The diameter of ribosomes is 230 A^0
II) Eukaryotes and Prokaryotes have both 80 S and 70 S ribosomes
III) 80S ribosomes are formed by association between 50 S and 30 S sub units
IV) Polyribosomes translate and produce different polypeptides
1) I only 2) I and III only
3) I, II, and III only 4) II and IV

169. Cell organelles concerned with the formation of cell plate are
I) Golgi complex II) Lysosomes
III) Ribosomes IV) Mitochonodria
1) I and II are correct
2) I and III are correct
3) III and IV correct 4) I only

170. Amembranous structures of the animal cell are
A) Ribosome B) Nucleolus
C) Centrosome
1) A only 2) ABC
3) AB only
4) A and C only

171. Conversion of leucoplasts to chloroplasts is found in
I) Tubers of Radish II) Potato tubers
III) Fruit of Tomato IV) Maize kernels
1) I and II only 2) II and III are correct
3) III and IV are correct
4) IV and II are correct

172. Find out the correct match with regard to stored food
I) Aleuroplasts–Proteins
II) Elaioplasts–Fats and Oils
III) RER - Glycogen
IV) Amyloplasts –Starch
1) I & II only 2) I,II,II & IV
3) I, II, & IV 4) I, III and IV

173. Common character found in chloroplasts and mitochondria is
I) Both involve in metabolism
II) Photophosphorylation
III) Both are semi autonomous organelles
IV) Both contain oxysomes
1) I & II 2) II & IV
3) I & III 4) III & IV

174. Carotenoids are found in
I) Chloroplasts II) Leucoplasts
III) Vacuole IV) Chromoplasts
1) I only 2) I and II
3) II and III 4) I and IV

175. Chloroplast does not not contain
I) Double membraned evelope
II) Grana and Stroma
III) Matrix and Cristae
IV) Circular DNA and 70 S ribosomes
1) I and IV 2) I and III
3) III only 4) II and IV

176. Correct statement regarding Mitochondria and Chloroplast

I) ATP synthesis is seen in both
II) Outer membrane has more surface in both
III) Circular naked DNA, RNA and 70S ribosomes are seen in both
IV) Oxidative phosphorylation occurs in both

1) I and II 2) II and III
3) I and III 4) I and IV

177. Single membrane bound organelles are

I) Lysosomes II) Peroxisomes
III) Ribosomes IV) Glyoxysomes

1) I and II 2) I, II and III
3) I, II and IV 4) I, II, III and IV

178. Double membraned envelope is found around

I) Nucleus II) Plastids
III) Mitochondria IV) ER

1) I and II 2) II and III
3) III and IV 4) I, II and III

TYPE - III

179. Some cellular structures bounded by single or double membranes, while some other without a membrane. Match the organelle in List I wiht the nature of mambrane in List II and select the correct answer using the codes given below the lists

List –I	List –II
A) Mitochondria	1) Without membrane
B) Lysosomes	2) Single membrane
C) Ribosomes	3) Double membrane
D) Nucleus	4) Double membrane with prosed

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

180. Match List I with II and select the correct answer using the codes given below the lists

List –I	List –II
A) Dictyosomes	1) Storage
B) Mitochondria	2) Photosynthesis
C) Vacuoles	3) Transport
D) Grana	4) Secretion
	5) Respiration

	A	B	C	D
1)	4	5	1	2
2)	3	4	2	1
3)	4	5	3	2
4)	4	3	1	2

181. Match list I with List II and select the correct answer

List –I	List –II
A) Nucleolus	1) Lipid storage
B) Spherosomes	2) Glycolate metabolism
C) Peroxisomes	3) Transport of macromolecules
D) Plasmodesmata	4) RNA synthesis

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

182. Match the following

List –I	List –II
A) Lysosomes	1) Protein synthesis
B) Ribosomes	2) Hydrolytic activity
C) Smooth endoplasmic reticulum	3) Steroidogenesis
D) Centriole	4) Glycolytic activity
E) Chromosomes	5) Repository of genetic information
	6) Formation of spindle apparatus

	A	B	C	D	E
1)	2	1	3	6	5
2)	6	3	4	5	1
3)	1	4	3	6	1
4)	4	3	1	2	5

183. Match the following

List –I	List –II
A) Karyolymph	1) Nucleolus
B) Ribonucleoprotein	2) Nucleus
C) Spindle fibre	3) DNA
D) Genes	4) Centrioles
E) Rough endoplasmic reticulum	5) Protein synthesis

	A	B	C	D	E
1)	1	3	2	4	5
2)	4	2	3	5	1
3)	2	1	4	3	5
4)	1	2	3	4	5

184. Match the following

List - I	List - II
A) Suicidal bags	I) Mitochondria
B) Power house of the cell	II) Lysosomes
C) Cell Brain	III) Nucleous
D) Plasmosome	IV) Chloroplast
	V) Nucleus

	A	B	C	D
1)	II	IV	V	III
2)	I	IV	V	III
3)	II	I	V	III
4)	II	IV	V	I

185. Match the following

List - I	List - II
A) Lysosome	I) Riosome synthesis
B) Nucleolus	II) Heredity
C) Nucleus	III) Secretion
D) Golgi complex	IV) Digestion

	A	B	C	D
1)	I	II	III	IV
2)	IV	I	II	III
3)	III	I	II	IV
4)	II	I	IV	III

186. Match the following

List - I	List - II
A)Mitochondria	I) Photorespiration
B) Peroxisomes	II) Aerobic respiration
C) Nucleus	III) Intracellular transport
D) E R	IV) Protein synthesis
	V) Heredity

	A	B	C	D
1)	II	I	IV	III
2)	IV	I	V	II
3)	I	IV	V	III
4)	II	I	V	III

187. Match the following

List - I	List - II
A)Glyoxysomes	I) Storage of food
B) Leucoplasts	II) Osmoregulation
C) Plasma membrane	III) Digestion
D) Nucleolus	IV) Ribosome synthesis
	V) Conversion of fat to carbohydrate

	A	B	C	D
1)	V	I	II	IV
2)	I	II	I	IV
3)	IV	II	III	I
4)	V	IV	III	I

188. Match the following

List - I	List - II
A)Mitochondrion	I) Cell with in a cell (Autotrophic endsymbiont)
B) Chloroplast	II) Suicide bag
C) Lysosome	III) Cell furnace
D) Vacuole	IV) Power house of cell
	V) Repository of cell

	A	B	C	D
1)	III	II	II	IV
2)	IV	I	II	III
3)	III	I	II	V
4)	IV	V	III	II

TYPE - IV
MULTIPLE MATCHING TYPE

189. Study the following Table

Cell organelle	Discoverer	Function
I. Ribosomes	Palade	Protein synthesis
II. Golgi complex	Golgi	DNA synthesis
III. Glyoxysomes	Bridenbach	Fat metabolism
IB. Nucleus	Robert brown	Cell plate

Which two show the correct combination ?

1) I and II 2) II and III 3) III and IV 4) I and III

190. Study the following table

Structure	Chlorophylls	Carotenes	Xanhophylls
I. Choloroplast	Present	Present	Present
II. Chromoplasts	Absent	Present	Present
III. Vacuoles	Absent	Present	Present
IV. Leucoplasts	Absent	Absent	Present

Which two are correct combinations ?

1) I and II 2) II and III 3) III and IV 4) I and IV

191. Study the following Table

Cell organelle	Scientist	Function
I. E.R	K.R porter	Production of Golgi complex
II. Lysosomes	Christian de Duve	Autolysis of cell
III. Peroxisomes	Rhodin	Photophosphorylation
IV. Glyoxysomes	Bridenbach	Calvin cycle

Which two are correct combinations ?

1) I and II 2) II and III 3) III and IV 4) I andIV

192. Study the following table

Cell structure	Common Name	Function
I) Lysosome	Repository of cell	Digestion of food materials
II) Mitochondria	Power house of the cell	Conversion of potential energy into kinetic energy
III)Nucleus	Cell Brain	Regulates the function of macrocellorganelles only
IV) Vacuole	Suicide bags of cell	Osmoregulatroy process

Correct combination is

1) I and IV 2) II alone 3) III and IV 4) II and III

193.

Cell organlle	Discovered by	Formed from	Enveloped by	Functions
I) Plasmosome	Fontana	Nucleolar	No unit	Synthesis of ribosmes
II)Idiosome	Golgi	E.R	One unit membrane	Cell wall material synthesis
III) Lysosome	de Duve	Golgi complex	Single unit /ER	Autolysis membrane
IV) Ergosome	Palade	Plasmosome	No unit membrane	Protein synthesis

Correct combinations are

1) All are correct 2) II & III 3) I, III & IV 4) I, II, & III

194. Study the following table

Cell organelle	discovered by	function
I) Lysosome	Christian Gram	Autolysis of cell contents
II) Plasmosomes	Fontana	Production of ribosomes
III)Idiosomes	Camello Golgi	Secretion of hormones
IV) Peroxisomes	Rhodin	Oxidation of Amino acids

The correct combination is

1) I & II 2) II & III 3) III & IV 4) II & IV

195. Study the following table and select the wrong combination

Structure	Plastid	Pigments
I) Petals	Chromoplasts	Carotenoids
II) Brown algae	Chromoplasts	Fucoxanthin
III) Red algae	Chromoplast	Phycoerythrin
IV) Blue green algae	Chloroplasts	Phycocyanin

1) I and II 2) II and III 3) III and IV 4) IV only

196. Study the following table

Cell organelle	Scientist	Function
I) Golgicomplex	Golgi	Biological oxidation
II) Ergosome	Palade	Protein synthesis
III) Glyoxysomes	Bridenbach	H_2O_2 degradation
IV) Lysosomes	de Duve	Autolysis of cell contents

Which two show the correct combination

1) II & IV 2) I & III 3) II & III 4) I & IV

197.

Structure	Formed from	Involved in
A) Plasmosome	M) ER	α) Polypetide sythesis
B) Ribosome	N)Dictyosome	β) Digestion of food
C)Idiosome	O)Secondary constiction	γ) Cellulose synthesis
D) Lysosome	P) Nucleoulus	Ω) Production of ergosomes

Identify the correct combination of A,B,C and D with those given in the second and third columns

	A	B	C	D
1)	$O\Omega$	$P\alpha$	$M\gamma$	$N\beta$
3)	$P\Omega$	$N\beta$	$O\gamma$	$M\alpha$

	A	B	C	D
2)	$O\alpha$	$M\Omega$	$P\beta$	$N\gamma$
4)	$N\beta$	$O\gamma$	$M\alpha$	$P\Omega$

TYPE - V
QUESTIONS FROM PREVIOUS MEDICAL ENTRANCE EXAMS

198. Stroma in the chloroplasts of higher palnts contain **(CBSE-AIPMT 2009)**
1) Light-independent reaction enzymes
2) Light-dependent reaction enzymes
3) Ribosomes 4) Chlorophyll

199. Middle lamella is mainly composed of **(CBSE-AIPMT 2009)**
1) Hemicellulose 2) Muramic acid
3) Calcium pectate
4) Phosphoglyceridesp

200. Plasmodesmata are **(CBSE-AIPMT 2009)**
1) Lignified cemented layers between cells
2) Locomotory structures
3) Membranes connecting the nucleus with plasmalemma
4) Connections between adjacent cells

201. Cytoskeleton is made up of (CBSE-AIPMT 2009)
1) Calcium phosphate granules
2) Callose deposits
3) Cellulosisc microfibrils
4) Proteinaceous filaments

202. Semiconservative replication of DNA was first demonstrated in **(CBSE-AIPMT 2009)**
1) Drosophila melanogaster
2) Escherichia coli
3) Streptococcus pneumoniae
4) Salmonella typhimurium

203. Keeping in view, the Fluid mosaic model for the structure of cell membrane, which respect to the movement of lipids and proteins from one lipid monolayer to the other (described as flip-flop movement **(CBSE-AIPMT 2008)**
1) Both lipids and proteins can flip-flop
2) While lipids can rarely flip-flop, proteins cannot
3) While proteins can flip-flop, lipids cannot
4) Neither lipids, nor proteins can flip-flop

204. Polysome is formed by **(CBSE-AIPMT 2008)**
1) Several ribosomes attached to a single mRNA
2) Many ribosomes attaced to a strand of endoplasmic reticulum
3) A ribosome with several subunits
4) Ribosomes attached to each other in a linear arrangement

205. The two subunits of ribosome remain united at a critical ion level of **(CBSE-AIPMT 2008)**
1) Copper 2) Manganese
3) Magnesium 4) Calcium

206. Vacuole in a plant cell (CBSE-AIPMT 2008)
1) Is membrane bound and contains storage proteins
2) Is membrane bound and contains water and excretory substances
3) Lacks membrane and contains air
4) Lacks membrane and contains water and excretory substances

207. In germinating seeds, fatty acids are degraded exclusively in the **(CBSE-AIPMT 2008)**
1) Proplastids 2) Glyoxisomes
3) Peroxisomes 4) Mitochondria

208. Which one the following is not a constituent of cell membrane **(CBSE-AIPMT 2007)**
1) Cholesterol 2) Glycolipids
3) Proline 4) Phospholipids

209. Select the wrong statement from the following **(CBSE-AIPMT 2008)**
1) Both chloroplasts and mitochondria contain an inner and an outer membrane
2) Both chloroplasts and mitochondria have an internal compartment, the thylakoid space bounded by the thylakoid membrane
3) Both chloroplasts and mitochondria contain DNA
4) The chloroplasts are generally much larger than mitochondria

210. Chlorophyll in chloroplasts is located in **(AFMC-2009)**
1) Grana 2) Oyrenoid
3) Stroma 4) Both (1) and (3)

211. Lysosomes are the reservoirs (store houses) of **(AFMC-2007)**
1) Hydrolytic enzymes
2) Secretory glycoproteins
3) RNA and protein

4) Fats (or sugars or ATP)

212. Which of the following cell structures is correctly matched with the accompanying description **(AIIMS 2009)**
1) Plasmamembrane – Outer layer of cel lulose of chitin on absent
2) Mitochondria – Bacteria like elements with inner membrane forming sacs containing chlorophyll found in plant cells and algae
3) Chloroplasts – Bacteria like elements with inner membrane highly folded
4) Golgi apparatus–Sacks of flattened vesicles

213. What is common between chloroplasts, chromoplasts and leucoplasts **(AIIMS 2008)**
1) Presence of pigments
2) Possession of thylakoids and grana
3) Storage of starch, proteins and lipids
4) Ablity to multiply by a fisson -like process

214. Assertion (A) : A cell membrane shows fluid behaviour
Reason (R) : A membrane is a mosaic or composite of diverse lipids and proteins **(AIIMS 2008)**

215. Golgi apparatus is absent in **(BHU-2008)**
1) Higher plant 2) Yeast
3) Bacteria and blue-green algae
4) Liver cells

216. Protein synthesis takes place in **(BHU-2008)**
1) Ribosomes 2) Chloroplasts
3) Mitochondria 4) Golgibodies

217. A genophore is made up of **(BHU-2007)**
1) A single double-stranded DNA
2) Asingle-stranded DNA
3) RNA and histones
4) Histones and non-histones

218. Membrane that covers the vacuole in a plant cell is called **(CPMT-2009)**
1) Tonoplast 2) Tonoplasm
3) Jacket 4) Cell membrane

219. Nuclear membrane is continuous with **(CPMT-2009)**
1) Rough endoplasmic reticulum
2) Smooth endoplasmic reticulum
3) Cell membrane 4) Golgi bodies

220. Cristae are associated with which of the following **(CPMT-2007)**
1) Mitochondrion 2) Cytoplasm
3) Protoplasm 4) Endoplasmic reticulum

221. Centrosome is not present in cell of **(CPMT-2007)**
1) Of higher plants 2) Of lower plants
3) Of higher animals 4) Of lower animals

222. Subunits of 80S ribosome are **(DUMET-2008)**
1) 40S 2) 60S
3) Both (1) and (2) 4) None of these

223. Which one of the following is not a plastid **(DUMET-2008)**
1) Mitoplast 2) Chromoplast
3) Chloroplast 4) Leucoplast

224. Fat storing granules are **(DUMET-2007)**
1) Elaioplast 2) Amyloplast
3) Aleuroplast 4) None of these

225. Subunits in prokaryotic ribosomes are **(DUMET-2007)**
1) 60S–40S 2) 50S–30S
3) 40S–30S 4) 50S–20S

226. Extension of plasma membrane in prokaryotic cell is **(DUMET-2007)**
1) Mesosome 2)Hapnoid
3) Ribosome 4) None of these

227. A cell organelle that is exceptionally rich in hydrolytic enzymes is **(Haryan PMT-2009)**
1) Ribosome 2) Endoplasmic reticulum
3) Lysosome 4) Mitochondria

228. RNA is not found in **(Haryan PMT-2009)**
1) Chromosome 2) Plasmalemma
3) Nucleolus 4) Ribosome

229. Highest number of enzymes are found in **(Haryan PMT-2008)**
1) Lysosome 2) Chloroplast
3) Mitochondria 4) Peroxisome

230. Which organelle is present in higher number in secretory cells **(Haryan PMT-2008)**
1) Dictyosome 2) ER
3) Lysosome 4) Vacuole

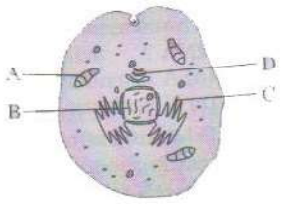
231. F_1 –particles are present in
1) Chloroplast 2) Mitochondria
3) Ribosome 4) Rough ER

232. Plastids of an etiolated plant possess
1) Phycobilins **(AMU-2008)**

2) Carotenoids and xanthophyll
3) Chlorophylloid and carotenoids
4) Chlorophyll and carotenes

233. The nucleolus is the site of formation of
1) Spindle fibres 2) Chromosomes
3) Ribosomes 4) Peroxisomes

234. The RER in the cell synthesised a protein which would be later used in building the plasma membrane. But it is observed that the protein in the membrane is slightly different from the protein made in the another cell organelle. Identify that organelle in the given diagram **(KCET -2009)**



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

235. Surrounding membrane of vacuole is called **(Pb PMT-2008)**
1) Tonoplast 2) Symplast
3) Apoplast 4) Phragmoplast

236. Fluid mosaic model of palsma membrane was given by **(Pb PMT-2008)**
1) Robertson 2) Robert Hooke
2) Singer and Nicholson
4) Pantin and Mast

237. Prokaryotic ribosome has sedimentation coefficient of **(Pb PMT-2007)**
1) 80S 2) 70S
3) 40S 4) 60S

238. Which of the following cell organelles is rich in catabolic enzymes **(Pb PMT-2007)**
1) Chloroplast 2) Mitochondria
3) Golgi complex 4) Ribosomes

239. A conspicuous rounded body present in nucleoplasm and attached to a particular chromosome at a definite place is **(Pb PMT-2007)**
1) Plasmid 2) Karyolymph
3) Nucleolus 4) Nuclear reticulum

240. Nucleolus is **(Pb PMT-2007)**
1) Rounded structure found in cytoplasm near nucleus
2) Rounded structure inside nucleus and having rRNA
3) Rod-shaped structure in cytoplasm near the nucleus
4) None of the above

241. Which of the following organelles is associated with photorespiration **(MP PMT-2009)**
1) Mitochondrion 2) Peroxisome
3) Chloroplast 4) All of these

242. Which of the following does not contain DNA **(MP PMT-2009)**
1) Mitochondrion 2) Chloroplast
3) Peroxisome 4) Nucleus

243. Which of the following is responsibel for the origin of lysosome **(MP PMT-2009)**
1) Chloroplast 2) Mitochondrion
3) Golgi body 4) Ribosome

244. Highest number of enzymes is found in **(MP PMT-2007)**
1) Lysosome 2) Chloroplast
3) Mitochondria 4) Peroxisome

245. Match the following **(KERALA PMT - 2008)**

List –I	List –II
A) Endoplasmic reticulum	1)Stack of cisternae
B) Spherosome	2) Store oils or fats
C) Dictyosome	3) Synthesis and storage of lipids
D) Peroxisome	4) Photorespiration
E) Elaioplasts	5) Detoxification of drugs

	A	B	C	D	E
1)	5	3	1	4	2
2)	5	3	2	4	1
3)	2	3	1	4	5
4)	4	3	1	5	2
5)	3	5	1	4	2

246. Read the following statemets and identify the correct options given **(KERALA PMT - 2008)**

I) Sap vacuoles – Contain digestive enzymes with the help of which nutrients are digested

II) Contractile vacuoles –Take part in

osmoregulation and excretion

III) Food vacuoles – Store and concentrate mineal salts as well as nutrients

IV) Air vacuoles – Store metabolic gases and hepl in buoyancy of cells

1) I and II are correct 2) I and III are correct
3) I and IV are correct 4) II and IV are correct
5) II and III are correct

247. Which of these is mis-matched

(KERALA PMT - 2007)

1) Amyloplasts – Store protein granules
2) Elaioplasts – Store oils or fats
3) Chloroplasts – Contain chlorophyll pingments
4) Chromoplasts– Contain coloured pigments othe then chlorophyll
5) Leucoplasts – contain colourless pigment.

248. Which of the following organelle in the figure correctly match with its function **[NEET 2013]**

(1) Golgi apparatus, protein synthesis
(2) Golgi apparatus, formation of glycolipids
(3) Rough endoplasmic reticulum, protein synthesis
(4) Rough endoplasmic reticulum, formation of glycoproteins

249. The Golgi complex plays a major role **[NEET - 2013]**

(1) in digesting proteins and carbohydrates
(2) as energy transferring organelles
(3) in post translational modification of proteins and glycosidation of lipids
(4) in trapping the light and transforming it into chemical energy

250. Match the following and select the correct answer (NEET 2014)

a. Centriole	i. Infoldings in mitochondria
b. Chlorophyll	ii. Thylakoids
c. Cristae	iii. Nucleic acids
d. Ribozymes	iv. Basal body cilia or flagella

	A	B	C	D
1	iv	ii	i	iii
2	i	ii	iv	iii
3	i	iii	ii	iv
4	iv	iii	i	ii

251. The osmotic expansion of a cell kept in water is chiefly regulated by (NEET 2014)

1. Mitochondira 2. Vacuoles
3.Plastids 4. Ribosomes

252. The solid linear cytoskeletal elements having a diameter of 6nm and made up of a single type of monomer are known as (NEET 2014)

1. Microtubules 2. Microfilaments
3. Intermediate filaments 4. Lamins

253. Which structures perform the function of mitochondria in bacteria? (NEET 2014)

1. Nucleoid 2. Ribosomes
3.Cell wall 4.Mesosomes

254. Select the correct matching in the following pairs (NEET 2015)

1. Rough ER-Oxidation of fatty acids
2. Smooth ER-Oxidation of phospholipids
3. Smooth ER-Synthesis of lipids
4. Rough ER- Synthesis of glycogen

255. Which one of the following is not an inclusion body found in prokaryotes? (NEET 2015)

1. Polysome 2. Phosphate granule
3. Cyanophycean granule 4. Glycogen granule

256. Nuclear envelope is a derivative of (NEET 2015)

1. Rough endoplasmic reticulum
2. Smooth endoplasmic reticulum
3. Membrane of Golgi complex
4. Microtubules

257. DNA is not present in (NEET 2015)

1. Mitochondria 2. Chloroplast
3.Ribosomes 4. Nucleus

258. Which of the following structures is not found in prokaryotic cells? (NEET 2015 Re)

1. Plasma membrane 2. Nuclear envelope
3.Ribosome 4.Mesosome

259. Which of the following is not membrane bound? (NEET 2015 Re)

1. Mesosomes 2. Vacuoles
3.Ribosomes 4. Lysosomes

260. Cellualr organelles with membranes are (NEET 2015 Re)

1. Lysosomes, Golgi apparatus and mitochondria
2. Nuclei, ribosomes and mitochondria
3. Chromosomes, ribosomes and endoplasmic reticulum
4. Endoplasmic reticulum, ribosomes and nuclei

261. Cell wall is absent in (NEET 2015 Re)

1. Nostoc 2. Aspergillus
3.Funaria 4. Mycoplasma

262. A protoplast is a cell (NEET 2015 Re)

1. Without cell wall
2. without plasma membrane
3. without nucleus
4. undergoing division

263. Match the columns and identify the correct option (NEET 2015 Re)

Column-I		Column-II	
a	Thylakoids	i	Disc-shaped sacs in Golgi apparatus
b	Cristae	ii	Condensed structure of DNA
C	Cisternae	iii	Flat membranous scas in stroma
d	Chromatin	iv	Infoldings in mitochondria

	a	b	c	d
1.	iii	iv	ii	i
2.	iv	iii	i	ii
3.	iii	iv	i	ii
4.	iii	i	iv	ii

264. Balbiani rings are sites of(NEET 2015 Re)

1. RNA and protein synthesis
2. Lipid synthesis
3. Nucleotide synthesis
4. Polysaccharide synthesis

265. Mitochondria and chloroplast are : (2016 NEET PHASE I)

1) Semi-autonomous organelles.
2) Formed by division of pre-existing organelles and they contain DNA but lack protein synthesizing machinery

Which one of the following options is correct ?

1) Both(1) and (2) are correct
2) (2) is true but (1) is false
3) (1) is true but (2) is false
4) Both (1) and (2) are false

266. Microtubules are the constituents of (2016 NEET PHASE I)

1) Cilia, flagella and peroxysomes
2) Spindle fibres, centrioles and cilia
3) Centrioles, spindle fibres and chromatin
4) Centrosome, nucleosome and centrioles

267. One of the major components of cell wall of most fungi is (2016 NEET PHASE I)

1) Chitin 2) Peptidoglycan
3) Cellulose 4) Hemicellulose

268. Which one of the following cell organelles is enclosed by a single membrane ? (2016 PHASE-I)
1) Mitochondria 2) Chloroplasts
3) Lysosomes 4) Nuclei

269. A cell organelle containing hydrolytic enzyme is (2016 NEET PHASE-II)
1. Ribosome 2. Mesosome
3.Lysosome 4.Microsome

270. Which of the following components provides sticky character to the bacterial cell ? (NEET 2017)
1) Cell wall 2) Nuclear membrane
3) Plasma membrane
4) Glycocalyx

271. Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP ? (NEET 2017)
1) Lysosome 2) Ribosome 3) Chloroplast 4) Mitochondrion

272. The Golgi complex participates in (NEET 2018)
1) respiration in bacteria
2) formation of secretory vesicles
3) fatty acid breakdown
4) activation of amino acid

273. Which of the following is true for nucleolus ? (NEET 2018)
1) It takes part in spindle formation
2) It is a membrane – bound structure
3) Larger nucleoli are present in dividing cells
4) It is a site for active ribosomal RNA synthesis

274. The shorter and longer arms of a submetacentric chromosome are referred to as (NEET 2019)
1) p-arm and q-arm, respectively
2) q-arm and p-arm, respectively
3) m-arm and n-arm, respectively
4) s-arm and i-arm, respectively

275. Which of the following pairs of organelles does not contain DNA ? (NEET 2019)
1) Chloroplast and Vacuoles
2) Lysosomes and Vacuoles
3) Nuclear envelope and Mitochondria
4) Mitochondria and Lysosomes

276. The concept of 'Omnis cellula –e-cellula' regarding cell division was first proposed by (NEET 2019)
1) Theodor Schwann 2) Schleiden
3) Aristotle 4) Rudolf Virchow

277. Which of the following cell organelles is present in the highest number in secretory cells ? (NEET 2019 - Odisha)
1) Mitochondria 2) Golgi complex
3) Endoplasmic reticulum 4) Lysosomes

278. Non-membranous nucleoplasmic structures in nucleus are the site for active synthesis of (NEET 2019 - Odisha)
1) protein synthesis 2) mRNA
3) rRNA 4) tRNA

KEY

MODEL TEST - I

1) 3 2) 2 3) 4 4) 1 5) 4
6) 4 7) 1 8) 1 9) 1 10) 2

MODEL TEST - II

11) 1 12) 3 13) 2 14) 4 15) 3
16) 3 17) 4 18) 2 19) 3 20) 1

MODEL TEST - III

21) 2 22) 1 23) 3 24) 1 25) 4
26) 3 27) 1 28) 2 29) 3 30) 2

TYPE - I

31) 1 32) 4 33) 1 34) 2 35) 4
36) 3 37) 4 38) 3 39) 4 40) 2
41) 2 42) 3 43) 4 44) 2 45) 3
46) 2 47) 2 48) 1 49) 3 50) 1
51) 2 52) 1 53) 1 54) 1 55) 3
56) 3 57) 2 58) 3 59) 1 60) 3

61) 2 62) 1 63) 2 64) 4 65) 4
66) 1 67) 1 68) 2 69) 4 70) 2
71) 2 72) 1 73) 1 74) 4 75) 4
76) 2 77) 4 78) 2 79) 1 80) 4
81) 1 82) 4 83) 3 84) 4 85) 2
86) 2 87) 3 88) 2 89) 1 90) 4
91) 4 92) 2 93) 3 94) 2 95) 2
96) 4 97) 3 98) 3 99) 4 100) 1
101) 2 102) 3 103) 3 104) 1 105) 3
106) 1 107) 4 108) 3 109) 2 110) 1
111) 2 112) 3 113) 1 114) 1 115) 1
116) 2 117) 4 118) 1 119) 3 120) 1
121) 1 122) 4 123) 1 124) 2 125) 4
126) 3 127) 2 128) 3 129) 3 130) 2
131) 1 132) 2 133) 3 134) 4 135) 3
136) 1 137) 4 138) 2 139) 4 140) 4
141) 3 142) 4 143) 2 144) 1 145) 3
146) 2 147) 3 148) 4 149) 2 150) 2
151) 2 152) 3 153) 3 154) 1 155) 4
156) 4 157) 1 158) 1 159) 3 160) 3
161) 4 162) 3 163) 2

TYPE - II

164) 1 165) 3 166) 4 167) 4 168) 1
169) 4 170) 2 171) 2 172) 3 173) 3
174)4 175) 3 176) 3 177) 3 178) 4

TYPE - III

179) 3 180) 1 181) 3 182) 1 183) 3
184) 3 185) 2 186) 4 187) 1 188) 3

TYPE - IV

189)4 190) 1 191)1 192) 2 193) 1
194) 2 195) 4 196) 1 197) 1

TYPE - V

198) 1 199) 3 200) 4 201) 4 202) 2
203) 2 204) 1 205) 3 206) 2 207) 2
208) 3 209) 2 210) 1 211) 1 212) 4
213) 4 214) 1 215) 3 216) 1 217) 1
218) 1 219) 1 220) 1 221) 1 222) 3
223) 1 224) 1 225) 2 226) 1 227) 3
228) 2 229) 3 230) 1 231) 2 232) 3
233) 3 234) 1 235) 1 236) 2 237) 2
238) 2 239) 3 240) 2 241) 4 242) 3
243) 3 244) 3 245) 1 246) 5 247) 1
248) 3 249) 3 250) 1 251) 2 252) 2
253) 4 254) 2 255) 1 256) 1 257) 3
258) 2 259) 3 260) 1 261) 4 262) 1
263) 3 264) 1 265) 2 266) 3 267) 1
268) 3 269) 3 270) 4 271) 4 272) 2
273) 4 274) 1 275) 2 276) 4 277) 2
278) 3

CH:10 - BIOMOLECULES

- Living organisms present on earth exhibit a great diversity in habit, habitat, life span, mode of nutrition and mode of reproduction etc...
- The chemical analysis of a plant tissue, an animal tissue,microbial paste(living matter) and a piece of earth's crust (non- living matter) describes that – all living and non living systems are made up of same chemicals i.e., elements (Carbon, hydrogen, oxygen and several other elements)
- The close examination of this chemical analysis indicates the relative abundance of carbon and hydrogen with respect to other elements is higher in living organisms than in earth's crust

Element	**% weight of the element in earth's crust**	**% weight of the element in Human body**
Hydrogen (H)	0.14	0.5
Carbon (C)	0.03	18.5
Oxygen (O)	46.6	65.0
Nitrogen (N)	Very little	3.3
Sulphur (S)	0.03	0.3
Sodium (Na)	2.8	0.2
Calcium (Ca)	3.6	1.5
Magnesium (Mg)	2.1	0.1
Silicon (Si)	27.7	Negligible

- The **ascending order** of elements according to their % weight in earth's crust
  N → C/S → H → Mg → Na → Ca → Si → (O)
- The **ascending order** of elements according to their % weight in Human body
  Si → Mg → Na → S → H → Ca → N → C → (O)
- The technique that is to be followed to know about the organic compounds present in the living organisms is – **Chemical analysis**
- To perform the chemical analysis, any living tissue is taken and (a vegetable or a piece of Liver) grind it in – Trichloroacetic acid (Cl_3CCOOH)
- The slurry obtained after grinding, during the chemical analysis is filtered through cheese cloth or cotton (this phenomenon divides the slurry into two parts i.e., acid soluble fraction or pool (**filtrate**) and acid insoluble fraction (**retentate**)
- The acid soluble pool or fraction of this slurry of a living tissue obtained during the chemical analysis has – thousands of organic compounds .
- Whenever the analytical techniques are applied to a compound, such an application gives an idea of – Molecular formula of the compound and probable structure of the compound.
- All the carbon compounds that we get from a living tissue can be called as - **Biomolecules.**
- A living organism is constituted by various types of organic compounds, various types of inorganic elements and
  inorganic compounds - water (Inorganic constituent)
- The ash analysis of a living tissue indicates the presence of Inorganic elements (Na^+, K^+, Ca^{++}, Mg^{++} etc...) – Inorganic compounds (NaCl, $CaCO_3$, PO_4^{3-}, SO_4^{2-} etc...)
- The elemental analysis gives the elemental composition of living tissues in the form of - Carbon, Hydrogen, Oxygen, Chlorine etc...
- An idea about organic constituents and inorganic constituents present in living organisms is provided by – **Chemical** (Elemental) **analysis**
- The weight of living tissue = wet weight
- Wet weight (Living tissue) – water = Dry weight
- The weight of Ash = weight of inorganic elements and compound
- Dry weight – weight of Ash = weight of Organic compounds
- The chemist classifies the chemical compounds of living organisms as Aldehydes, Ketones, Aromatic compounds etc...
- A bio-chemist classifies the chemical compounds of living organism as Amino acids, Nucleotide bases, Fatty acids etc...
- **Amino acids :**
- The structural units of a protein are – Amino acids
- The building blocks of a protein – Amino acids
- An organic compound having an amino group (-NH_2) and an acidic group(-COOH) as substituents on the same carbon i.e., α-Carbon is known as – α-Amino acids.
- The amino acids are – **Substituted Methanes**

- The four substituents groups occupying the four valency positions of α-Carbon of an amino acid are – 1) Carboxyl group(COOH) (Acidic group) 2) Hydrogen (H) 3) Amino group (NH_2) (Basic group) 4) Functional or variable group (R group)
- The amino acids are many types based on the – Nature of R group
- Based on the involvement in the formation of proteins, the amino acids present in the cells are classified into two types and they are: 1) Non protein amino acids which do not form the proteins (about 170 amino acids) 2) Protein amino acids that form proteins (which are only of **21** types)
- In a proteinaceous amino acid, if R-group is Hydrogen, the amino acid is – Glycine
- In a proteinaceous amino acid, if R-group is Methyl group, the aminoacid is – Alanine
- In a proteinaceous amino acid, if R-group is Hydroxy methyl, the amino acid is – Serine
- The physical and chemical properties of amino acid are in accordance to – Amino group,Carboxyl group and R–functional group
- Based on the number of amino groups and carboxyl groups present, the amino acids are of different types and they are – Acidic amino acids (Glutamic acid)- Basic amino acids (Lysine) - Neutral amino acids (Valine)
- The aromatic amino acids are Tyrosine, Tryptophan and Phenylalanine
- The particular property (Main) of amino acids is – The Ionizable nature of amino group ($-NH_2$) and carboxyl group (– COOH)
- The structure of amino acids changes in the solutions of different pHs because of - the Ionisable nature of amino group ($-NH_2$) and carboxyl group (– COOH)
- The carboxyl group (– COOH) has the property of being acidic because it easily looses the terminal H of its OH and becomes COO^- i.e., releases the H^+ ion in solution
- The amino group has the property of being basic or alkaline because it attract H^+ ion to become NH_3
- Thus the amino acids are acid on one end and base on other end. Hence the two amino acids reacts as an acid reacts with a base producing an union of the reacting amino acids called peptide bonding
- A tri-peptide contains – Three amino acids and two peptide bonds
- The enzyme that catalyses the formation of peptide bond between two amino acids is – **Peptidyl transferase**
- **Essential amino acids:**
- The amino acids that have to be supplied through diet and essential for our health care are – **Essential amino acids**
- The essential amino acids have to be supplied through diet because – They are not synthesised in the body
- The essential amino acids are – Lucine, Isolucine, Lysine, metheonine, Phenylalanine,Tryptophan and valine
- **Lipids**:
- Lipids are generally – **Water insoluble** (insoluble in polar solvents like water)
- Lipids are soluble in – Benzene, Ether and Chloroform (non-polar solvents
- **Fatty acid**:($C_nH_{2n}O_2$)
- Fatty acid is a - simple form of lipid
- A Fatty acid has a carboxyl group attached to an R – group
- The –R group of fatty acid could be a Methyl (CH_3) or Ethyl ($-C_2H_5$) or higher number of – CH_2 groups (1 carbon to 19 carbons)
- The 16 carbon fatty acid is – Palmatic acid($C_{16}H_{32}O_2$):**$CH_3-(CH_2)_{14}-COOH$** (Including carboxyl carbon)
- The 20 carbon fatty acid is – Arachidonic acid($C_{20}H_{40}O_2$):**$CH_3-(CH_2)_{18}-COOH$** (Including carboxyl carbon)
- The fatty acids without double bonds are – Saturated fatty acids
- The saturated fatty acids are – Palmitic acid and Arachidonic acid
- The fatty acids with one or more C = C double bonds – unsaturated fatty acids

Glycerol:

- Glycerol is a – simple form of lipid

- The Glycerol is – Trihydroxy propane

Glycerides:

- Many lipids have - both Glycerol and fatty acids (Neutral or True lipids)
- An organic compound in which the fatty acids are found esterified with glycerol is - Glyceride
- The Glycerides are – Monoglycerides, Diglycerides and Triglycerides.
  Triglyceride (R_1, R_2 and R_3 are fatty acids)
- The lipids are classified into fats and oils based on – the melting point
- The lipids with lower melting points are – Oils (Gingely oil, remains as oil in winter)

Phospholipids:

- Lipids having phosphorus and a phosphorylated organic compounds are **Phospholipids**
- Phospholipids are abundantly found in cell membrane
- A phospholipid is – Lecithin (Phosphatidyl choline): $C_{44}H_{86}NO_8P$
- The neural tissues have lipids with - more complex structures
- Cholesterol:($C_{27}H_{45}OH$)
- Cholesterol is a- fat soluble steroid alcohol
- The most abundant steroid in the animal tissue
- Cholesterol is abundant in food which is rich in animal fats
- The site of synthesis of cholesterol is Liver

Nucleotide bases:

- Examples for a number of carbon compounds having heterocyclic rings found in living organisms are - Nucleotide bases (A, G, C, T, U) (Adenine, Guanine, Cytosine, Thymine & Uracil)
- The total number of types nitrogen bases found in Nucleic acids - 5 (A, G, C, T, U)
- A Combination of pentose sugar and Nitrogen base is – Nucleoside (Nitrogen base + Pentose sugar = Nucleoside)

Nucleosides of DNA	Nucleosides of RNA
A + $C_5H_{10}O_4$ = Adenosine	A + $C_5H_{10}O_5$ = Adenosine
G + $C_5H_{10}O_4$ = Guanosine	G + $C_5H_{10}O_5$ = Guanosine
T + $C_5H_{10}O_4$ = Thymidine	U + $C_5H_{10}O_5$ = Uridine
C + $C_5H_{10}O_4$ = Cytidine	C+ $C_5H_{10}O_5$ = Cytidine

- Nucleotides are present only in – DNA and RNA
- The DNA and RNA functions as Genetic material
- RNA function as genentic material in – most of the phytophages (TMV) few of zoophages (Influenza and poilo virus)

Primary and Secondary Metabolites

- When one analyses plant, fungal and microbial cells, one would see thousands of compounds that constitute primary and secondary metabolites
- Primary metabolites have identifiable functions and play known roles in normal physiological processes.
- The role or funcitons of all the 'secondary metabolites' in host is not known but many of them are useful to human welfare

Some Secondary Metabolites :

Pigments - Carotenoids, Anthocyanins, etc...
Alkaloids-Morphine, Codeine, etc.
Terpenoides-Monoterpenes, Diterpenes etc.
Essential oils- Lemon grass oil, etc
Toxins- Abrin, Ricin
Lectins -Concanavalin A
Drugs -Vinblastin, curcumin, etc.
Polymeric substances - Rubber, gums, cellulose

BIOMACROMOLECULES

- Biomolecules found in living organisms are of two types. One, those which have molecular weights **less than one thousand dalton** and are usually referred to as **micromolecules** or simply biomolecules while those which are found in the acid insoluble fraction are called **macromolecules** or **Biomacromolecules**.
- The acid insoluble fraction, has only four types of organic compounds i.e. proteins, nucleic acids, polysaccharides and lipids .
- These classes of compounds with the exception of lipids (around 800 daltons) have molecular weights in the range of ten thousand daltons and above
- The molecules in the insoluble fraction with the exception of lipids are polymeric substances.
- Lipids, whose molecular weights do not exceed 800 Daltons, come under acid insoluble fraction.
- Lipids are indeed small molecular weight compounds and are present not only as such but also arranged into structures like cell membrane and other membranes.
- When we grind a tissue, we are disrupting the cell structure. Cell membrane and other

membranes are broken into pieces and form vesicles which are not water soluble.

- Therefore, these membrane fragments in the form of vesicles get separated along with the acid insoluble pool and hence in the macromolecular fraction.
- **Lipids are not strictly macromolecules.**
- The acid soluble pool represents roughly the cytoplasmic composition.
- The macromolecules from cytoplasm and organelles become the acid insoluble fraction.
- Together they represent the entire chemical composition of living tissues or organisms.

Average Compositon of Cells :

Component	**% of the total cellular mass**
Water	70-90
Proteins	10-15
Carbohydrates	3
Lipids	2
Nucleic acids	5-7
Ions	1

Proteins:

- The Proteins are – Organic compounds
- The Proteins are – Bio macromolecules
- The polymers of amino acids are – Proteins
- The long chains of amino acids are – Proteins
- The Proteins are obtained as a portion of – Macromolecular fraction
- The molecular weight of Proteins is – 10000 or More than 10,000 Daltons
- The Proteins are obtained as a portion of– Acid insoluble fraction of living tissue
- The building blocks of Proteins are – Amino acids
- Proteins are – Polypeptides
- The linear chain of amino acids linked by peptide bonds is – Protein
- The number of amino acids and peptide bonds found in a tetra peptide respectively are – 4 and 3
- The number of types of proteinaceous amino acids is – 21 types
- The maximum number of types of amino acids found in proteins are – 21 types
- The polymer of amino acids is – protein
- A protein is a heteropolymer and not a homopolymer because it is a polymer of – different monomers (amino acids)
- A polymer having only one type of monomer repeating 'n' number of times – Homopolymer
- The amino acids that have to be supplied through diet which are essential for our health are – Essential amino acids
- The essential amino acids have to be supplied through diet because – They are not synthesised in the body
- The essential amino acids are – Lucine, Isolucine, Lysine, metheonine, Phenylalanine, Tryptophan and threonine, histidine valine
- Our body can make some of the amino acids which are – Non essential amino acids
- The amino acids that can be synthesised by our body by utilising existing precursors or ingested substances are – Non essential amino acids
- The most abundant protein in animal world is– Collagen
- The triple helical structure of the most abundant protein in animal world was first discovered by – G. N. Ramachandran
- The structural unit of Collagen – Amino acid
- The most abundant protein in plant kingdom is– RUBISCO (Ribulose bisphosphate Carboxylase – oxygenase)
- The most abundant protein in the whole of the biosphere is – RUBISCO (Ribulose bisphosphate Carboxylase – Oxygenase)

Protein	**Functions**
Collagen	Intercellular ground substance
Antibody	Fights infectious agents
Trypsin	Digestive enzyme (digests proteins)
Receptor	Sensory reception (smell, taste etc...)
Insulin	Hormone (controls blood sugar)
GLUT – 4	Enables glucose transport into cells (transportation of nutrients across cell membrane)

Structure of Proteins:

- A heteropolymer containing strings of amino acids – Protein
- In inorganic chemistry, the structure of a chemical compound invariably refers to the – Molecular formula (NaCl, $MgCl_2$, etc...)
- Organic chemists always write the – Two dimensional view of the molecules while representing the structure of the molecules (Benzene, Naphthalene, etc...)
- The physicists describes the molecular structure of a compound in – Three dimensional views
- The biologists describes the protein structure at – Four levels

Primary structure:

- The linear sequence of amino acids or the positional information of amino acids in a protein is refers to as – Primary structure
- The structure of protein that describes which is the first amino acid, which is second and so on is – Primary structure
- The left end of a protein imagined as a line (polypeptide chain) is represented by the– First amino acid (Methionine)
- The first amino acid of a polypeptide chain (Protein) is called as – N-terminal amino acid
- The amino acid found towards the extreme left end of a polypeptide chain is called as – N-terminal amino acid
- The right end of a protein imagined as a line (polypeptide chain) is represented by the – Last amino acid
- The Last amino acid of a polypeptide chain (Protein) is called as – C-terminal amino acid
- The amino acid found towards the extreme Right end of a polypeptide chain is called as – C-terminal amino acid
- The direction of synthesis of a polypeptide is – N terminal to C terminal
- The structure that gives the complete description of the covalent connections of a protein is – Primary structure

Secondary structure:

- The folding of a linear polypeptide chain into a specific coiled (Helix)structure is referred to as – the secondary structure of protein
- The helices observed in the secondary structure of a protein are – Only right handed helices

Tertiary structure:

- The structure that exhibits the bending and folding of protein upon itself like a hollow woollen ball (sphere) is – Tertiary structure
- The structure that gives us a 3-dimensional view of protein is– Tertiary structure
- The structure that gives us a view of protein with active sites is– Tertiary structure
- The structure that is absolutely necessary for the many biological activities of proteins is – Tertiary structure

Quaternary structure:

- Quaternary structure is exhibited by a protein which is - an assembly of more than one polypeptide chains or subunits
- Quaternary structure is exhibited by a protein which has – two or more polypeptide chains or subunits
- The arrangement of polypeptide chains or subunits of a protein with respect to each other gives the – Quaternary structure
- In the quaternary structure of a protein, the individual folded polypeptides or subunits are arranged as – linear string of spheres, Spheres arranged one upon each other in the form of a cube or plate
- A protein with four polypeptides or subunits is – Adult human Haemoglobin(the oxygen transporting protein of Blood)
- Out of four polypeptides of an adult human Haemoglobin – two are identical to each other
- The human Haemoglobin(Hb) is constituted by – two subunits of α -type and two subunits of β -type
- **Nature of Bond linking monomers(amino acids) of a polymer (Protein):**
- In a polypeptide chain or a protein, the amino acids are linked by – Peptide bonds
- The number of amino acids and peptide bonds found in a tetrapeptide – 4 and 3

- The peptide bond is formed in between the -carboxyl group of previous amino acid and amino group of next amino acid (-COOH of 1st amino acid and –NH_2 of 2nd amino acid)
- During the formation of a peptide bond, the moiety removed is – Water moiety
- The peptide bond is formed by – Dehydration (removal of water moiety)
- The enzyme that catalyses the formation of peptide bond – Peptidyl transferase
- According to IUB system of classification, the enzyme that catalyses the formation of peptide bond formation is a member of – II class – Transferases
- The peptidyl transferase is found – at larger sub unit of ribosome(50S) in P-site

Polysaccharides:

- The Polysaccharides are–Organic compounds
- The Polysaccharides are-Bio macromolecules
- The polymers of Monosaccarides are – Polysaccharides
- The long chains of sugars are– Polysaccharides
- The long chains of sugars of polysaccharides are – either unbrached (Chitin) or branched (Glycogen)
- In a polysaccharide chain the right end is called – Reducing end
- In a polysaccharide chain the Left end is called –Non-Reducing end
- The Polysaccharides are obtained as a portion of– Macromolecular fraction
- The molecular weight of Nucleic acids is – 10000 or More than 10,000 Daltons
- The Polysaccharides are obtained as a portion of – Acid insoluble fraction of living tissue
- The building blocks of Polysaccharides are – Monosaccarides
- The long threads containing different Monosaccharides as the building blocks are - Polysaccharides
- The Polysaccharides found as homopolymers are –Starch, Cellulose, Glycogen and Inulin
- A polymer of Fructose is - Inulin
- A polymer of Glucose(Homopolymer) – Starch, Cellulose, Glycogen

Starch:

- Starch is a – Polysaccharide
- Starch is a – Homopolymer
- Starch is a – Polymer of Glucose
- The repeating monomer of starch is – Glucose
- The store house of energy in the plant tissue – Starch
- In most of the plants the reserve food is – Starch
- The major fuel in plants is – Starch
- The most abundant polysaccharide found in plants is – Starch
- The starch forms – Helical secondary structure
- The starch can hold iodine molecules (I_2) in-Helical portions
- The starch I_2 is in – Blue colour
- The conformation test for starch is – Iodine test

Cellulose:

- Cellulose is a – Polysaccharide
- Cellulose is a – Homopolymer
- Cellulose is a – Polymer of Glucose
- The repeating monomer of Cellulose is – Glucose
- Cellulose does not exhibit – Complex helices (Secondary structure)
- Cellulose cannot hold iodine(I_2) because it has – No complex helices
- The cellulosic structures are – Cell walls of plants – paper made up of with plant pulp – Cotton fibre – Flax fibre
- The most abundant polysaccharide found in plants next to starch is – Cellulose

Glycogen:

- Glycogen is an –Animal Polysaccharide
- Glycogen is a – Homopolymer
- Glycogen is a – Polymer of Glucose
- The repeating monomer of Glycogen is – Glucose
- The glycogen is - a long branched chain of sugars with a right reducing and a left non reducing end
- **Complex Polysaccharides (Heteropolymers):**
- **The complex polysaccharides are - Heteropolymers**
- The polysaccharides having amino sugars and chemically modified sugars as monomers are - Complex Polysaccharides

- The building blocks of Complex Polysaccharides are – amino sugars and chemically modified sugars
- The building blocks of complex polysaccharides are – Glucosamine,- N-acetyl galactosamine
- Peptidoglycon is - heteropolymer and polysaccharide
- The bacterial cell wall is made up of with – Peptidoglycon

The peptidoglycon is constituted by – NAG (N-acetyl glucosamine) and NAM (N-acetyl muramic acid)

Chitin:

- The chitin is a – Complex polysaccharide and a homopolymer(contains glucosamine)
- The chitinous structures are – Fungal cell wall, Exoskeleton of Arthropods
- Agar, pectin are complex polysaccharides and Heteropolymers having – N – acetyl galactosamine
- **Nature of Bond linking monomers(Monosaccharides)of polymer(Polysaccharide):**
- The bond found in between two successive Monosaccharides of a Polyccharides– Glycosidic bond
- The bond found in between glucose and fructose is – Glycosidic bond
- In between two Monosaccharides, the glycosidic bond is formed during the removal of – water moiety
- The glycosidic bond is formed due to – Dehydration (removal of water)
- In a polysaccharide the glycosidic bond is formed in between – two carbon atoms of two successive Monosaccharides
- The individual Monosaccharides of a polysaccharide are linked by – Glycosidic bond

Nucleic acids:

- The Nucleic acids are–Organic compounds
- The Nucleic acids are–Bio macromolecules
- The polymers of Nucleotides are – Nucleic acids
- The long chains of Nucleotides are – Nucleic acids
- The Nucleic acids are obtained as a portion of – Macromolecular fraction
- The molecular weight of Nucleic acids is – 10000 or More than 10,000 Daltons
- The Nucleic acids are obtained as a portion of– Acid insoluble fraction of living tissue
- The building blocks of Nucleic acids are – Nucleotides
- The polynucleotides are – Nucleic acids
- The three distinct components of a Nucleotide are-1)Heterocyclic compound (Nitrogen bases)

2) Monosaccharide (Ribose in RNA($C_5H_{10}O_5$) and 2'deoxyribose in DNA($C_5H_{10}O_4$) – 3)Phosphate or Phosphoric acid

- The number of types of nitrogen bases found in nucleic acids – 5 types
- The number of types of purines found in nucleic acids – 2 types (A and G)
- The number of types of pyrimidines found in nucleic acids – 3types (T, U and C)
- The pyrimidines found in DNA are – T and C
- Out of two types of pyrimidines found in DNA – One is methylated(T) and the other is Non – Methylated(C)
- Out of two types of pyrimidines found in RNA – both are Non – Methylated(U & C)
- The thymine differs from Uracil in having a methyl group(CH_3) at – 5th carbon positions
- The pyrimidines found in RNA are– U and C
- The common pyrimidine found in both DNA and RNA is – Cytosine
- Instead of Uracil the DNA contains – Thymine
- Instead of Thymine the RNA contains - Uracil
- The number of types of nucleosides found in nucleic acids – 8 types
- The number of types of nucleotides found in the nucleic acids – 8 types
- The monosaccharide found in RNA is - Ribose($C_5H_{10}O_5$)
- The monosaccharide found in DNA is - 2'deoxyribose ($C_5H_{10}O_4$))
- The monosaccharide of DNA is deficient in one oxygen atom at – 2nd carbon position (2'deoxyribose ($C_5H_{10}O_4$))

- The monosaccharide of DNA differs from the monosaccharide of RNA in having a – deficiency of an oxygen atom at 2nd carbon position
- In a ribose the oxygen atom is found in between – 1st carbon and 4th carbon
- In a Nucleotide the nitrogen base is attached to – 1st carbon of monosaccharide

HOTS

Complimentary base pairs :

1. A = T / T=A Two hydrogen bonds found in between A & T
   G ≡ C / C ≡ G Three hydrogen bonds found in between G & C

Chargaff rule : Purines: Pyrimidines = 1:1

A+G = C+T

A = T, G=C

A+T ≠ G+C

Chargaff rule is not applicable to s.s. DNA/s.s RNA

Types of Nucleosides and Nucleotides = 8

1. Adenine +Ribose = Adenosine
   Adenosine+Phosphate = Adenylic acid
2. Adenine+deoxyribose = Deoxy adenosine
   Deoxy adenosine+p = Deoxy adenylic acid
3. Guanine+ Ribose = Guanosine
   Guanosine + p = Guanilic acid
4. Guanine+Deoxyribose = Deoxy Guanosine
   Deoxyguanosine+p = Deoxyguanylic acid
5. Cytosine +Ribose = Cytidine
   Cytidine + p = Cytidilic acid
6. Cytidine + deoxyribose = Deoxycytidine
   Deoxycytidine +p = Deoxycytidylic acid
7. Thymine+Deoxyribose =Deoxy thymidine
   Deoxy thymidine+p = Deoxythymidilic acid
8. Uracil+Ribose = Uridine
   Uridine + Phosphate = Uridylic acid

Nature of bond linking monomers (Nucleotide) of a polymer(Nucleic acid)

- The two successive nucleotides of a polynucleotide strand are linked by – Phosphodiester bond
- A Phosphodiester bond is formed between – 3rd carbon of sugar of a nucleotide and 5th carbon of sugar of succeeding nucleotide
- The moiety that links the 3rd carbon of sugar of a nucleotide and 5th carbon of sugar of succeeding nucleotide of a polynucleotide strand is – Phosphate moiety
- The bond formed in between the phosphate and hydroxyl group of sugar is – Ester bond
- Whenever the successive nucleotides of a polynucleotide strand are linked by phosphate moiety, one ester bond is present on either side of phosphate. Hence the formed bond is called as Phosphodiester bond
- The nucleic acids exhibit a - wide variety of secondary structures
- The DNA exhibits – secondary helical structure(Double Helix)
- The molecular structure of DNA was first described by – Watson and Crick
- The model proposed by Watson and Crick to explain the molecular structure of DNA is – Double helix
- The DNA is usually found as – Double helix (contains two polynucleotide strands)
- Single stranded DNA is found in – M 13 bacteriphage – Ø X 174 bacteriophage
- The two polynucleotides of a DNA molecule are – Opposite and anti-parallel to one another (5'end one strand is found opposite to 3'of other strand)
- The back bone of a polynucleotide strand is formed by– Sugar – phosphate – sugar chain
- The nitrogen bases of a polynucleotide strand are oriented more of less– perpendicular to the back bone of the strand but face inside
- The A present in one strand of DNA pairs with – T in opposite strand
- The T present in one strand of DNA pairs with – A in opposite strand
- The G present in one strand of DNA pairs with – C in opposite strand
- The C present in one strand of DNA pairs with – G in opposite strand
- Between A and T – two hydrogen bonds are present(A = T)
- Between G and C – three hydrogen bonds are present(G = C)

- The purine of DNA exhibit complementarity with – Pyrimidines
- The A + G of DNA = T + C of DNA
- The DNA molecule appears as – Helical straircase
- One full turn (coil) of DNA can accommodate – 10 pairs of Nitrogen bases (20nitorgen bases)
- At each step of ascent the DNA strand turns – 36^0
- The angle between successive base pairs of a DNA molecule - 36^0
- The pitch of each coil is – $34A^0$
- A rise in pitch per base pair is – $3.4A^0$
- The most common type of DNA – B – DNA
- The minimum number of hydrogen bonds found in a coil of B – DNA is - 20
- The maximum number of hydrogen bonds found in a coil of B – DNA is – 30
- The number of types of DNA's found in living organisms –more than 12 types represented by English alphabets with unique structural features
- **Dynamic state of the Body Constituents:**
- The organic compounds found in the living organisms (Bacterial cell, a protozoan, a plant or an animal) are known as – Bio molecules (Metabolites)
- In living organisms the Bio molecules are present in-certain or definite concentrations (mols/cell or mols/litre)
- The biomolecules of the living organisms have constantly being changed into some other biomolecules (Hydrolysis of polys-accharides into monosaccharides) and also made from some other biomolecules (synthesis of protein by the use of amino acids).These phenomena can be described as – Turn over of biomolecules
- The Turnover of biomolecules means – Breaking and making of Biomolecules
- The breaking and making of Biomolecules is due to- the chemical reactions constantly occurring in living organisms
- All the biochemical reactions that occur in living organisms responsible for the breaking and making of biomolecules (Turnover) together referred to as – Metabolism
- The metabolic reaction result in – the transformation of biomolecules
- A metabolic transformation or conversion – Amino acid–CO_2=Amine–Removal of amino group in a nucleotide base–Hydrolysis of glycosidic bond in a disaccharide (sucrose) to form Monosaccharides(glucose and fructose)
- The bond found in between Glucose and fructose of sucrose – Glycoside bond)
- The metabolic reactions of living organisms generally – do not occur in isolation but are always linked to some other reactions
- In living organisms the metabolic conversion is carried out by a series of linked reactions called as – Metabolic path ways
- The metabolic path ways are – either Linear (Glycolysis) or Circular (C_3,C_4 pathway)
- The flow of metabolites through metabolic path way has a – Definite rate and Direction
- The metabolite flow in a definite rate and direction through metabolic path way is called as – Dynamic state of body constituents
- When the interlinked metabolic traffic is very smooth and without any mishap the condition is – Healthy condition
- Any mishap in metabolic traffic of a living organism is – Disease (Disorder)
- All the metabolic reactions are – Catalysed
- Uncatalysed metabolic conversion is – Absent in living organisms
- Dissolution of CO_2 in water, a physical process that occur in a living organism is - Catalysed reaction (C_4 plants)
- The catalyst that hastens the rate of a given metabolic conversion - Protein

MODEL TEST - I

1. 98% of living organism is formed of six elements-carbon, hydrogen, nitrogen, oxygen and
   1) S & Mg 2) Mg & Na
   3) Ca & P 4) P & S
2. Glucose is
   1) Cane sugar 2) Grape sugar
   3) Malt sugar 4) Triose sugar

3. Pentose and hexoses are common
1) Oligosaccharides 2) Disaccharides
3) Monosaccharides 4) Polysaccharides
4. Which of the following is present in acid insoluble fraction ?
1) Glucose 2) Fructose 3) Alanine4) Lipid
5. Which of the following secondary metabolites is a polymeric substance ?
1) Ricin 2) Monoterpenes
3) Curcumin 4) Rubber
6. Which of the following is the most abundant element present in human body ?
1) Carbon 2) Hydrogen
3) Oxygen 4) Nitrogen
7. Which of the following is a primary metabolite ?
1) Carotenoid 2) Glucose
3) Morphine 4) Cellulose
8. Which of the following is a secondary metabolite as well as a drug ?
1) Concanavalin A 2) Vinblastine
3) Diterpenes 4) Ricin
9. Inulin is a polymer of
1) Fructose 2) Glucose 3) Mannose 4) Ribose
10. Plant cell walls are made of
1) Homopolymer of fructose
2) Heteropolymer of glycogen
3) Homopolymer of glucose
4) Homopolymer of glycogen
11. As starch is related to plant body, which of the following polysaccharides is related to animal body ?
1) Cellulose 2) Chitin
3) Glycogen 4) Inulin
12. Cotton fibre is made up of
1) Cellulose 2) Glycogen
3) Chitin 4) Starch
13. Iodine test can detect the presence of
1) Starch 2) Cellulose
3) Both 1 & 2 4) Chitin
14. Which of the following is a structural polysaccharide ?
1) Glycogen 2) Starch
3) Inulin 4) Cellulose
15. Which of the following is mismatched ?
1) Chitin - Polymer of glucosamine
2) Glycogen - Polymer of glucose
3) Cellulose - Heteropolysaccharide
4) Inulin - Homopolysaccharide
16. Unbranched polymer of glucose is
1) Starch 2) Glycogen
3) Cellulose 4) Chitin
17. Which of the following is the most abundant carbohydrate in biosphere ?
1) Starch 2) Glycogen
3) Cellulose 4) Hemicellulose

MODEL TEST - II

18. Which of the following bonds are present in between the two amino acids of a protein
1) Glycosidic bond
2) Phosphodiester bond
3) Peptide bond 4) Ionic bond
19. Which bonds are present inbetween the monosaccharides of polysaccharide
1) Glycosidic 2) Phosphodiester bond
3) Peptide bond 4) Ionic bond
20. In which of the following bond formations dehydration process is occured
1) Peptide bond & phosphodiester bond
2) Peptide bond & Glycosidic bond
3) Glycosidic bond & Phosphodiester bond
4) Between purines and Pyrimidines
21. Bond existing between sugar and Nitrogen base of Nucleic Acid is
1) Ester bond 2) Glycosidic bond
3) Hydrogen bond 4) Phosphodiester bond
22. Phosphodiester bond is formed between the following carbons of deoxy ribose sugars
1) 1st & 2nd 2) 4th & 5th
3) 1st & 3rd 4) 3rd & 5th
23. Number of double bonds found in any pyrimidine molecule is
1) 2 2) 3 3) 4 4) 5
24. Number of double bonds present in any purine molecule is
1) 4 2) 5 3) 2 4) 1
25. In Pyrimidine nucleoside bond developed between carbon of sugar and nitrogen of Nitrogenbase
1) C_1 - N_3 2) C_1 - N_1
3) C_5 - N_3 4) C_5 - N_1
26. In Purine nucleoside bond developed between

carbon of sugar and Nitrogen of Nitrogen base
1) C_1 - N_9 2) C_1 - N_7
3) C_1 - N_1 4) C_1 - N_3

27. Sucrose is a disaccharide it is composed of two monosaccharides, which bond is present between them
1) Ionic 2) Disulphide
3) Peptide 4) Glycosidic

QUESTION BANK
TYPE - I

1. Following elements are relatively more in a living tissue than earth's crust
1) C, H,P 2) N,P 3) C,H 4) Ca, Mg
2. Percentage weight of element that is very little in earth's crust and negligible in human body respectively are
1) N, S 2) C, Mg
3) Si, Na 4) N, Si
3. % weight of the element that is highest both in earth's crust and human body is
1) N 2) O 3) Mg 4) S
4. When a tissue is burnt to ashes, ash contains
1) all biomolecules 2) Acid insoluble substance
3) Inorganic elements 4) All non essential elements
5. Organic acid used to grind a living tissue in order to analyse chemical composition is
1) Chloroform 2) Hydrochloric acid
3) Oxalo acetic acid 4)Trichloro acetic acid
6. Acid soluble pool in the filtrate consists of
1) Organic compounds
2) Inorganic compounds
3) Only mineral elements 4) 1 and 2
7. Elements present in all biomolecules are
1) C, H, O 2) N, Ca, Mg 3) H, O, P 4) N, P, S
8. All the carbon compounds present in living tissues are
1) Organic compounds 2) Inorganic compounds
3) Biomolecules 4) 1 & 3
9. Dry weight (biomass) of a plant constitutes
1) Organic, inorganic substances with water
2) only inorganic substances
3) Organic and inorganic substances excluding water
4) only organic substances
10. Amino acids may be in the form of
1) substituted methanes
2) with amino and acidic groups
3) with variable R group 4) all the above

11. Amino acid in zwitterionic from possess
1) Only negative charge 2) no charge
3) both positive and negative charge
4) only positive charge

12. Lipids are called fats or oils based on
1) double bonds 2) melting point 3) boiling point 4) ester bonds

13. Number of carbons in palmitic acid excluding carboxyl carbon is
1) 16 2) 19 3) 20 4) 15

14. By having the following group at á-carbon, the amino acid Alanine differ from Glycine
1) H (Hydrogen) 2) NH_2
3) COOH 4) CH_3

15. Which of the following is a ephosphorylated nucleotide
1) Andenylic acid 2) Guanylic acid 3) Adenine 4) Uridine

16. Find the correct pair from the following
1) Morphine - Terpinoid 2) Abrin – Lectin
3) Curcumin – Drug 4) Rubber-Pigment

17. Which one of the following is not a secondary metabolite
1) Rubber 2) Glucose
3) Spices 4) Colored pigments

18. Element which is negligible amounts in human body is
1) Silicon 2) Nitrogen 3) Magnesium 4) Sulphur

19. Number of amino acids involved in biosynthesis of proteins is
1) 21 2) 25 3) 10 4) 15

20. Rubbers, Gums, cellulose are examples of
1. Toxins 2. Drugs
3. Alkaloids 4. Polymeric substances

21. Phosphorus and phorphorylated organic compound containing lipid and which is present in cell membrane is
1. Lectin 2. Glycine
3. Lysine 4. Lecithin

22. A nucleotide consists of the following bonds
1. Glycosidic bond, peptide bond
2. Ester bond, covalent bond
3. Glycosidic bond, ester bond
4. Peptide bond, ester bond

23. During the process of chemical analysis the living tissue is grinded by using a mortar and a pestle in the presence of a chemical what is the formula of that chemical ?
1. C_2H_5OH 2. CH_3COOH
3. CH_3COCH_3 4. Cl_3CCOOH

24. The ratio between the number of carbon atoms present in arachidonic acid and palmitic acid is
1. 4:5 2. 5:4 3. 1:1 4. 2:3

25. Study the following ionizable state of amino acids

$H_3^+N-C\underset{(X)}{\overset{R}{\overset{|}{H}}}-COOH$ $H_3^+N-C\underset{(Y)}{\overset{R}{\overset{|}{H}}}-COO^-$

$H_2N-C\underset{(Z)}{\overset{R}{\overset{|}{H}}}-COO^-$

Find the zwitter ionic form from the above states
1. x 2. y 3. z 4. x,y,z

26. Antibodies that help to fight against infectious agents are
1. Polysaccharides 2. Amino acids
3. Proteins 4. Glucose

27. A DNA molecule is having 15% cytidylic acid molecules. In that number of hydrogen bonds in between polynucleotide strands are 460. Estimate the length of that DNA
1. 340 A^0 2.680 A^0 3.510 A^0
4. Data is not sufficient

28. Bioenergetics deals with
1. The total sunlight energy trapping mechanism in organism in nature in detail
2. The energy converstions which are occuring outside of the earth planet
3. Energes transfer from non-living things to living things
4. How living organisms derive their energy, on what way they store, how do they convert energy into work

29. FInd the number of hydrogen bonds and phosphodiester bonds present between the nucleotides which are present in the DNA having 119 A^0 length and 18 thymine bases in it

1. 70, 70 2. 70,69
3. 87,68 4. 87,70

30. N-terminal and C-terminal in polypeptide chain indicate the following respectively
1. Last amino acid and first aminoacid
2. First aminoacid and last aminoacid
3. Middle aminoacid and last aminoacid
4. First aminoacid and middle aminoacid

31. Which structure is absoluletly necessary for biological activities of protein ?
1. Primary structure
2. Secondary structure
3. Quatenary structure
4. Tertiary structure

32. The following secondary metabolite belongs to lectins
1. Concanavalin A 2. Abrin
3. Vinblastin 4. Cellulose

33. The relative abundance of the following elements with respect to other elements is higher in human body than in earths crust
1. Carbon, calcium, oxygen
2. Carbon, hydrogen, oxygen
3. Calcium, magnesium, hydrogen
4. Oxygen, Magnesium, Hydrogen

34. Elemental analysis of a leaf tissue reveals the presence of
1. Simple acid-soluble organic molecules
2. Inorganic compounds like sulphates, phosphates etc
3. Elements like C, H, O, Cl etc.
4. Only elements essential to plants

35. A triglyceride consists of
1. Three glycerols esterified to each other
2. Three fatty acids esterified to glycerol molecule
3. Three glycerols esterified to one fatty acid molecule
4. Three fatty acids esterified to each other

36. Number of carbon atoms in Palmitic acid is
1. 20 2. 19 3. 18 4. 16

37. The biomolecule found in the macromolecular fraction of the living tissue with small molecular weight among the following is :
1. Polysaccharides 2. Lipids
3. Protein 4. Nucleic acid

38. Find the odd man out
1. Lecithin 2. Triglyceride
3. Palmitic acid 4. Concanavalin-A

39. The most abundant chemical found in living organisms next to the most abundant inorganic constituent of living organisms among the following is
1. Water 2. Carbohydrate
3. Protein 4. Nucleic acid

40. In a primary structure of a protein
1. Last amino acid is also called N-terminal amino acid
2. Left end is represented by the last aminoacid
3. Right end is represented by the last aminoacid
4. First aminoacid is also called C-terminal amino acid

41. The correct pair of biomolecules, in which the former is an aromatic aminoacid, where as the latter is a toxin
1. Tyrosine and Morphine
2. Tryptoplan and Vinblastin
3. Phenylalanine and Ricin
4. Lysin and Abrin

42. Triple helical nature of collagen was discovered by
1. P. Maheswari 2. G.N. Ramachandran 3. Nirenberg 4. H.G. Khorana

43. Trihydroxy propane is
1. Palmitic acid 2. Arachidonic acid
3. Glycerol 4. Glycine

44. Aromatic amino acids are
1. Glycine and Tyrosine
2. Tryptophan and phenylalanine
3. Tyrosine and Tryptophan
4. Glycine and Phenylalanine

45. The following compound enables glucose transport into cells
1. Collagen 2. Vinblastin
3. GLUT-4 4. Concanavalin-A

46. An α helix is the example of which type of protein structure
1. Primary 2. Secondary
3. Tertiary 4. Quatenary

47. A DNA molecule contain 120 Adenines and 120 Guanines. Find the length of DNA and hydrogen bonds respectively
1. 81.6nm and 600 hydrogen bonds
2. 816nm and 600 hydrogen bonds
3. 600 hydrogen bonds and 816 nm
4. 8.16nm and 600 hydrogen bonds

48. The living state is a non-equillibrium steady state to be able to perform work and it is achieved by
1. Interlinked pathways
2. Input of energy
3. Interconversion of metabolites
4. Release of energy

49. In a polysaccharide the individual monosaccharides are linked by
1. Ester bond 2. Hydrogen bond
3. Glycosidic bond 4. Peptide bond

50. If a fragment of DNA molecule consists of 10% adenine and 100 hydrogen bonds between nitrogen bases. What is its length
1. 1020 A^0 2. 680 A^0
3. 2040 A^0 4. 850 A^0

51. A DNA molecule of angle 180^0 with 134 bonds may show
1. 3 Pairs of A, T and 3 pairs of G, C
2. 2 Pairs of A, T and 3 Pairs of G, C
3. 3 pairs of A, T and 2 pairs of G, C
4. 4 Pairs of A, T and 2 Pairs of G, C

52. Estimate the angle of a DNA fragment of six base pairs20. Adult human haemoglobin consists of
1. 2 subunits of 2 types
2. 4 subunits of one type
3. 4 subunits of 4 types
4. 4 subunits of 2 types

53. A characteristic of unsaturated fats is that they
1. Denature as they cool
2. Are made up of glucose and fructose
3. Are made up of aminoacids and glycerol
4. Have double bonds in their carbon chains

54. Which of the following are components of a phospholipid ?
1. Cholesterol, glycerol, fatty acids
2. Fatty acids, phosphate group, glycerol
3. Glycerol, aminoacids, phosphate group
4. Phosphate group, cholesterol, monosaccharides

55. Compared to saturated fats, unsaturated fats contain less
1. Oxygen 2. Glycerol
3. Hydrogen 4. Fatty acids

56. A lipids molecule is produced when
1. Fatty acids bond to glycerol
2. Aminoacids bond to glyceron
3. Monosaccharides bond to glycogen
4. Dehydration occurs between fatty acids and glycogen

57. Lipids are composed of
1. Nucleotides 2. Amino acids
3. Monosaccharides
4. Glycerol and fatty acids

58. I dentify the amino acid from the following in which 'R' group is - CH_2OH
1. Glycine 2. Serine
3. Alanine 4. All

59. Haemoglobin has
1. Primary structure
2. Secondary structure
3. Tertiary structure
4. Quatenary structure

60. What is the blood concentration of glucose in normal healthy individual
1. 4-0 to 5-0 mM 2. 5.0-5.5mM
3. 4.5-5.0mL 4. 4.5-5.0mM

61. Bio energetics deals with
1. Energy utilizations in living cells
2. Energy conversions in living cells
3. Energy productions in living cells
4. Energy conversions in a reactor

62. In a primary structure of a protein
1. Right end represented by last amino acid
2. Left end represented by last amino acid
3. First amino acid is also called as C-terminal amino acid
4. Last amino acid is also called as N-terminal amino acid

63. Molecule with reducing and non reducing ends is
1) Glucose 2) Glycogen
3) DNA 4) Lipid

64. Carboxyl and amino groups are found in
1) Amino acid 2) Lipids
3) Polysaccharide 4) Nitrogen base

65. Molecule that exhibits $5^1 \longrightarrow 3^1$ polarity is
1) DNA 2) RNA 3) Protein 4) 1 and 2

66. Molecules that have glycosidic bonds are
1) Nucleic acids, Proteins
2) Polysaccharides, Nucleic acids
3) Monosaccharides, Proteins
4) Lipids, Nucleic acids

67. 'R' group in aminoacids Serine and Alanine respectively are
1) H, CH_2 2) CH_2OH, CH_3
3) NH_2, CH_2 4) CH_3, CH_2OH

68. Carbon atoms of pentose sugars involved in ester bond in nucleic acids is
1) 1, 9 2) 3, 9 3) 3, 9 4) 1, 1

69. The aromatic aminoacid, Acidic aminoacid and aminoacid with methyl as R group respectively are
1) Alanine, Glutamic acid Tyrosine
2) Tryptophan, Glutamic acid and Alanine
3) Phenyl alanine, Alanine and valine
4) Glycine, Lysine and Alanine

70. Monomers in proteins, nucleic acids and polysaccharides are made of these structural units respectively
1) Peptides, nucleotides, monosaccharides
2) Amino acids, sugars, nucleotides
3) Amino acids, nucleotides, monosaccharides
4) Amino acids, nucleosides, starch

71. Choose the correct set of components found in a nucleotide
1) Homocyclic compound, penta saccharide, phosphate
2) Heterocyclic compound, pentose sugars, phosphoric acid
3) Homocyclic compound, monosaccharide, phosphoric acid
4) Nitrogen bases, polysaccharide, phosphate

72. In the primary structure of a protein
1) Three dimensional view is observed
2) First amino acid has C – terminal end and last amino acid has N – terminal end
3) Amino acids are arranged as a line
4) Protein chain is folded upon itself like a hollow woolen ball

73. Protein molecule that has more than one polypeptide exhibits
1) Tertiary structur 2) Primary structure
3) Quaternary structure 4) Secondary structure

74. Secondary metabolites that act as drugs are
1) Morphic, codeine 2) Abrin, Ricin
3) Vinblastin, curcumin
4) Rubber, gums, cellulose

75. Secondary metabolites useful to human welfare are
1) Spices, drugs , rubber
2) Carbohdyrates, proteins, nucleic acids
3) Alkalolids, amino acids, sugars
4) Proteins, pigments, sugars

76. Identify the correct set with all nucleosides from the following
1) Guanosine, thymidine, adenine
2) Cytidine, uridine, guanosine
3) Uridine, guanine, thymidine
4) Adenosine, cytidine, thymin

77. A nucleotide consists of the following bonds
1) Glycosidic bond, peptide bond
2) Ester bond, covalent bond
3) Glycosidic bond, ester bond
4) Peptide bond, ester bond

78. Cellulose consists of
1) A chain of glucose molecules
2) A chain of fructose molecules
3) Complex helices that cannot hold I_2
4) Glycosidic bonds and ester bonds

79. The organic compounds present in acid insoluble fraction are
1) Proteins and lipids 2) Nucleic acids
3) Polysaccharides 4) 1, 2 and 3

80. The compounds that have molecular weight above 10,000 daltons are
1) Proteins and lipids
2) Nucleic acids and protein
3) Lipids and polysaccharides
4) Proteins, nucleic acids and Polysaccharides

81. All the organic compounds have high molecular weight except
1) Proteins 2) Lipids
3) Nucleic acids 4) Polysaccharides

82. Bio-micromolecules are
1) Organic molecules whose molecular weight is less than one thousand daltons
2) All organic molecules that are present in acid insoluble pool
3) All organic molecules that are present in acid soluble pool
4) All organic molecules whose molecular weight is less than 2000 daltons

83. The biomolecule which are present in acid insoluble fraction are called as
1) Biomicromolecules 2) Biomacromolecules
3) Micromolecules 4) Macromolecule

84. The polymeric substances in acid insoluble fraction are
1) All organic molecule except proteins
2) All organic molecules except nucleic acids
3) All organic molecules except lipids
4) All organic molecules except polysaccharides

85. The molecular weight of lipids
1) do not exceed 800 daltons
2) above 1000 daltons
3) above 10,000 daltons
4) less than 800 daltons

86. The organic molecule of small molecular weight present in structures like cell membrane and other membrane is
1) protein 2) polysaccharides
3) nucleic acids 4) lipids

87. Among the organic molecules of acid insoluble pool the following compounds are not strictly macromolecules
1) proteins 2) nucleic acids
3) lipids 4) polysaccharides

88. The percentage of water of the total cellular mass is
1) 10 – 50% 2) 5 – 7%
3) 70 – 90% 4) 3 – 30%

89. Linear chains of amino acids that are linked by peptide bonds are
1) Lipid 2) Nucleic acid
3) Proteins 4) Both 1 and 2

90. Homopolymer is a
1) Repeated units of monomers
2) A particular number of monomers
3) Excessively branched monomers
4) Monomers of low molecular weight

91. The most abundant protein is animal world is
1) Trypsin 2) Inulin
3) Collagen 4) GLUT – 4

92. The most abundant protein in the whole of the biosphere is
1) RUBISCO 2) Collagen
3) Trypsin 4) Inulin

93. The following protein that acts as hormone
1) Collagen 2) Trypsin
3) Insulin 4) RUBISCO

94. Polymeric polysaccharide consisting of only one type of monosaccharide is
1) Callose 2) Pectose
3) Cellulose 4) Galactose

95. The only one type of monosaccharide present in cellulose is
1) Fructose 2) Glucose
3) Sucrose 4) Pectose

96. Store house of energy in plant tissues is
1) Proteins 2) Glycogen
3) Starch 4) Inulin

97. Store house of energy in animal tissues is
1) Protein 2) Glycogen
3) Starch 4) Inulin

98. Inulin is a polymer of
1) Glucose 2) Fructose
3) Mannose 4) Ribose

99. In paper pulp, cotton fibre, plant cell wall the common polysaccharide present in
1) Cellulose 2) Hemi cellulose
3) Lipid 4) Pectin

100. The building block of nucleic acid is
1) Nucleoside 2) Nucleotide
3) Sugar 4) Nitrogen base

101. A heterocyclic compound + monosaccharide + phosphoric acid constitute
1) Nucleoside 2) Nucleotide
3) Polysaccharide 4) 1 and 2

102. The total number of nitrogen base (types) in nucleic acid are
1) 5 2) 4 3) 6 4) 8

103. Purines in nucleic acids are
1) Adenine and Guanine
2) Thymine and Cytosine
3) Adenine and Thymine
4) Guanine and Cytosine

104. Pyrimidines are
1) Adenine and Thymine
2) Guanine and Cytosine
3) Cytosine and Adenine
4) Thymine, Cytosine, Uracil

105. The nitrogen base present in DNA but absent in RNA
1) Adenine 2) Guanine
3) Thymine 4) Cytosine

106. The positional information in a protein can be given by
1) Primary structures
2) Secondary structures
3) Tertiary structures
4) Quaternary structure

107. Long protein chain folded itself like a hollow woollen ball like is
1) Primary 2) Secondary
3) Tertiary 4) Quaternary structure

108. Adult human haemoglobin consisting of 2 sub units of α types and 2 sub units of β type that explains
1) Primary 2) Secondary
3) Tertiary 4) Quaternary

109. A peptide bond of amino acid is formed in between
1) Amino group of one amino acid
2) Carboxyl group of one amino acid to amino group of other amino acid
3) Between 2 amino groups of 2 amino acids
4) Between 2 carboxylic group of 2 amino acids

110. Chose the correct feature about biomacromolecules
1) Molecular weight is less than one thousand Daltons
2) Found in acid insoluble fraction
3) Includes lipids which are polymers
4) Found in plant ashes

111. In a nucleic acid phosphate moiety links to _____ and _____ carbon of the sugar of succeeding nucleotide
1) 3^{rd} and 5^{th} carbon 2) 1^{st} and 2^{nd} carbon
3) 2^{nd} and 4^{th} carbon 4) 3^{rd} and 4^{th} carbon

112. The bond between the phosphate and hydroxyl group of sugar is
1) Hydrogen bond 2) Ester bond
3) Peptide bond 4) Phosphodiester bond

113. Double helical model of DNA was given by
1) Watson and Crick 2) Chargaff
3) Pauling 4) Wilkins and Franklin

114. This constitutes the backbone of DNA molecule
1) Sugar phosphate – sugar chain
2) Nitrogen bases
3) Nucleotide 4) Nucleoside

115. The minimum number of hydrogen bonds and maximum number of hydrogen bonds present in each coil
1)20, 20 2)20,30 3)30,20 4)30,40

116. The number of hydrogen bonds present in between adenine and thymine, guanine and cytosine are
1)2 and 3 2)3 and 3
3) 3 and 2 4) 2 and 2

117. The breaking and making is through chemical reactions. These two process together called
1) Anabolism 2) Catabolism
3) Metabolism 4) Biochemicalprocess

118. The catalyst which hastens the rate of a given metabolic conversion are
1) Lipids 2) Polysaccharides
3) Proteins 4) Nucleotides

119. The protein that show catalytic power are
1) Lipids 2) Polysaccharides
3) Nucleotides 4) Proteins

120. The metabolic pathway that occur in skeletal muscles explains
1) glucose become lactic acid
2) acetic acid become cholesterol
3) glucose become pyruvic acid 4) glucose become ethyl alcohol

121. The metabolic pathway that is considered as endergonic process
1) Anabolism 2) Catabolism
3) Metabolism 4) Biochemical pathway

122. Conversion of glucose into lactic acid in our skeletal muscles explain
1) Anabolism 2) Catabolism
3) Metabolism 4) Biochemical pathway

123. In process like biosynthesis, osmotic and mechanical work the energy that is utilized is
1) chemical energy 2) radiant energy
3) bond energy 4) hot energy

124. The most important form of energy currency in a living system is
1) ATP 2) ADP 3) GDP 4) GTP

TYPE - II

125. Find out the correct statement from the following
I. Most abundant protein in animal world is RuBISCO
II. Some proteins act as a intercellular ground substance
III. Most abundant protein in entire biosphere is collagen
IV. Some proteins act as receptors
1. I and II correct 2. II and III correct
3. II and IV correct 4.I,II,III and IV correct

126. Identify the correct expressions from the following statements. (Regarding elemental analysis of living tissue)
I. The weight of a fresh vegetable = wet weight
II. Wet weight of a living tissue-all the water = Dry weight of the tissue
III. The weight of Ash=Weight of inorganic constituents except water
IV. Weight of organic constituents = Dry weight - weight of Ash
1. I and II only 2. I, II and III only
3. I and IV only 4. I, II, III and IV

127. The most exciting aspect of chemistry deals with
I. Isolation of thousands of chemical compounds from living organism
II. Determination of the structure of isolated chemical compounds
III. Determination of synthetic mechanisms of chemical compounds of living organisms
1. Except I 2. Except II
3. I and II only 4. I, II and III

128. Correct statements regarding reductionist biology are
A. It enables us to describe the various processes in molecular terms
B. It will tell us what types of organic compounds are present in living organisms
C. It can explain the unusual processes that occur during any diseased condition
D. It is a physico chemical approach to study and understand living organisms
1. D only 2. A and D only 3. A, B and D only 4. A, B, C and D

129. The anabolic pathways of the following are
A. Conversion of glucose to lactic acid
B. Conversion of acetic acid to cholesterol
C. Conversion of glucose to CO_2 and H_2O
D. Formation of sucrose from CO_2 and H_2O
1. A, B 2. C,D 3. A,C 4. B, D

130. Study the following statements and identify the correct statements :
I.Living state is non-equilibrium steady state
II. The system at equillibrium cannot perorm work
III. The living process is a constant effort to prevent the system falling into equillibrium
IV. Without metabolism there cannot be a living state
1. III and IV only 2. I, III and IV only 3. II and III only 4. I, II, III and IV

131. Select the set of correct statement from the following :
I. Biomolecules have turn over
II. Every metabolic reaction is a catalysed

reaction
III. Living state is an equillibrium steady state to be able to perform work
IV. Living state and metabolism are synonymous
1. All 2. Except II
3. Except IV 4. Except III

132. Find the correct statement
1. Biomacromolecules are found in the acid soluble fraction
2. The compounds found in the acid soluble pool have a common feature ie; molecular weight ranging from 18 to 800 daltons
3. Acid insoluble pool represents cytoplasmic composition only
4. Acid soluble pool is due to macromolecules from cytoplasm and cell organelles

133. Read the following statements :
a) Different froms of DNA named after english aplhabets
B) Different proteins have different number of aminoacids
C) Different metabolic reactions are catalysed by different enzymes
D) Different nucleotides of DNA have different sugars
1. Except D all are wrong
2. A and B only correct
3. All are correct 4. D only wrong

134. Find the incorrect statement from the following :
1. Aminoacids are substituted methanes
2. Chemical and physical properties of aminoacids essentially depends on their amino, carboxyl and the R-functional groups
3. When a tissue is analysed for its chemical composition, sulphates and phosphates are observed only in the acid soluble fraction
4. Relative abundance of carbon and hydrogen with respect to other elements is higher in any living orgaism than in earths crust

135. Identidy the incorrect statement
I. No uncatalysed metaqbolic conversions in living system
II. Living state is a non-equilibrium steady state to be able to perform work
III. Peptide bond formation and glycoside bond formations are dehydration reactions
Iv. Ester bonds present between nucleotide pairs of opposite strands of DNA
1. Only III 2. I, III and IV
3. Only IV 4. Only II

136. Identify the correct statement
1. In a metabolic pathway in which glucose is converted into lactic acid occurs in eight metabolic steps
2. In a DNA molecdule two strands of polynucleotides are parallel and complimentary to each other
3. The back bone of DNA is formed by sugar-phosphate-nucleotide chain
4. In a cell living process is a constant effort to prevent falling into equillibrium

137. Correct statements regarding reductionist biology are
A. It enables us to describe various processes in molecular terms
B. It will tell us what types of organic compounds are present in living organisms
C. It explain the unusual processes that occur during any diseased condition
D. It is a physico chemical approach to study and understand living organisms
1. D only 2. A and D only
3. A, B and D only 4. A, B, C and D

138. Identify the true statement
I. Majority of metabolic reactions occur in isolation but are not always linked to some other reactions
II. Living state is non-equillibrium steady state
III. Biomolecules of a cell have a turn over
IV. Back bone of DNA is formed by the alternate linkages between sugar and nitrogen bases
1. I, II, III, IV 2. II and III
3. II and IV 4. I, II and IV

139. Non-nitrogenous biomolecules among the following are
I. Polyasaccharides II. Nucleic acids
III. Proteins IV. Lipids
1. I only 2. I and II only
3. I and IV only 4. I, III and IV

140. A complex polysaccharide chitin is found in
I. Plant cell wall II. Exoskeletons of arthropods
III. Cell wall of fungi
IV. Bacterial cell wall
1. I, II, III, IV 2. II and IV only
3. II and III only 4. I only

141. Identify the correct statement with respect to proteins
1. It is a component of the retentate
2. They are homopolymers
3. Consists of branched chains of amino acids
4. Each protein contains 21 types of amino acids

142. Identify the correct expression from the following statements :
1. All the aminoacids found in the cell are proteinaceous
2. Most of the cellular aminoacids are proteinaceous
3. Most of the cellualr aminoacids are non-proteinaceous
4. Aminoacids are neither acidic (or) neutral

143. Find the incorrect statement :
1. Aminoacids are linked by peptide bonds by dehydration
2. In a polysaccharide the individual monosacharides are linked by glycosidic bond
3. The bond between phosphate and hydroxyl group of sugar in a DNA molecule is an ester bond
4. The bond between purine of one strand to the pyrimidine of other strand of DNA is ester bond

144. Identify the incorrect statement from the following :
1. Photosynthesis is an anabolic process 2. Respiration is a good exaqmple for catabolism
3. Anabolic pathways always energy
4. Energy currenc liberated of path of the cell is ATP

145. Identify the incorrect statement with respect to DNA double helical structure
1. Show secondary structure
2. The pitch of each helix is $34A^0$
3. At each step of ascent the strand turns 36^0
4. The rise per base pair would be $3.4A^0$

146. Identify a true statement regarding a double helical molecule of DNA
1. Each strand is identical
2. Both strands are parallel to each other
3. Back bone is formed by the sugar phosphate nitrogen base
4. Bases are perpendicular to axis

TYPE - III

147. Match the following lists with reference to aminoacids :

List - I	**List - II**
A. Hydroxymethyl group	I. Valine
B. Acidic	II. Cytidilic acid
C. Neutral	III. Tyrosine
D. Aromatic	IV. Serine
	V. Glutamic acid

The correct match is :

	A	B	C	D
1.	IV	V	I	III
2.	IV	V	I	II
3.	IV	V	II	I
4.	IV	I	II	III

148. Study the following lists :

List - I	**List - II**
A. Morphine	I. Toxin
B. GLUT-4	II. Drug
C. Curcumin	III. Alkaloid
D. Ricin	IV. Sensory receptor
	V. Glucose transport (Protein)

The correct match is :

	A	B	C	D
1	III	V	II	IV
2.	III	V	II	I
3.	II	III	I	IV
4.	III	I	II	IV

149. Match the following lists :

List - I (Protein structure)	**List - II (Shape)**
A. Quatenary	I. Linear thread
B. Primary	II. Hollow woolen ball
C. Secondary	III. Coiled spring
D. Tertiary	IV. Cube
	V. Plate

The correct match is :

	A	B	C	D
1.	V	I	III	II
2.	IV	III	V	I
3.	V	III	IV	I
4.	IV	I	II	V

150. Study the following and identify the correct match :

List - I Proteinaceous amino acids	**List - II R-Group**
A. Serine	I. Hydrogen
B. Glycine	II. Hydroxy methyl
C. Alanine	III. Methyl group

The correct match is :

	A	B	C
1.	III	I	II
2.	II	III	I
3.	I	II	III
4.	II	I	III

151. Study the following list, and choose the correctg match :

List - I Protein	**List - II Funciton**
A. Insulin	I. Sensory reception
B. Collagen	II. Hormone
C. Receptor	III. Biocatalyst intercellular
D. Trypsin	IV. Enzyme
	V. Ground substance

The correct match is :

	A	B	C	D
1.	II	V	III	IV
2.	II	IV	I	V
3.	III	V	I	IV
4.	II	V	I	III

152. Match the following tables

List - I Element	**List - II % weight of Earth's crust**
I. Hydrogen	1. 46.6
II. Oxygen	2. 27.7
III. Sulphur	3. 2.1
IV. Silicon	4. 0.14
	5. 0.03

The correct match is :

	I	II	III	IV
1.	1	4	5	3
2.	3	1	4	2
3.	5	3	2	4
4.	4	1	5	2

153. **Study the tables**

List - I Component	**List - II % of total cellular mass**
I. Lipids	1. 1
II. Nucleic acids	2. 2
III. Protein	3. 5-7
IV. Ions	4. 70-90
	5. 10-15

The correct match is :

	I	II	III	IV
1.	2	5	3	1
2.	2	3	5	1
3.	3	2	5	1
4.	5	2	1	4

154. Match the following tables :

List - I (Protein)	**List - II (Function)**
I. Amino acid	1. Uridine
II. Nucleoside	2. Glycerol
III. Carbohydrate	3. Ribose
IV. Fatty acid	4. Adenylic acid
	5. Alanine

The correct match is :

	I	II	III	IV
1.	3	1	2	4
2.	5	1	3	4
3.	5	4	3	2
4.	5	1	3	2

155. Match the following tables :

List - I Components	List - II Bonds
I. Aminoacids	1. Glycosidic bonds
II. Monosacchardies	2.Phosphodiester bonds
III. Nitrogen bases	3. Peptide bonds
IV. Nucleotides	4. Ester bond
	5. Hydrogen bonds

The correct match is :

	I	II	III	IV
1.	3	5	1	2
2.	3	2	5	1
3.	3	1	2	4
4.	3	1	5	2

156. Match the folloiwng tables :

List - I Compounds	List - II Types
I. Amino acids	1. 8
II. Nitrogen bases	2. 5
III. Purines	3. 3
IV. Pyrimidines	4. 21
	5. 2

The correct match is :

	I	II	III	IV
1.	2	1	4	5
2.	2	4	1	3
3.	4	2	5	3
4.	4	2	1	5

157. Match the folloiwng :

List - I	List - II
A. Store house of energy in plants	1. Glycogen
B. Store house of energy in animals	2. Homopolymer
C. Plant cell wall material	3. Chitin
D. Fungi cell wall	4. Glucose
	5. Starch

The correct match is :

	A	B	C	D
1.	1	2	4	5
2.	5	1	3	2
3.	5	3	2	1
4.	5	1	2	3

TYPE - IV

158. FInd out the correct matches from the folllowing table :

Element	% weight of earth's crust	% weight of Human body
I. Carbon	0.03	18.5
II. Nitrogen	Very little	3.3
III. Sodium	2.8	0.2
IV. Calcium	1.5	3.6
V. Magnesium	2.1	0.1

1. Except-IV 2. Except-II
3. Except-III 4. Except-I

159. Identify the correct matching :

List - I	List - II	List - III
A. Rubber	Latex	Polymeric Secondary Metabolites
B. Gums	Latex	Polymeric Secondary Metabolites
C. Cellulose	Polysaccha-rides	Peptide bonds
D. Curcumin	Drug	Secondary Metabolite

1. A,B 2. A,B,C 3. A,D 4. B,C,D

160. Identify the correct matching :

List - I	List - II	List - III
A. DNA	Phosphodies-ter bonds	Nucleotide Polymer
B. RNA	Hydrogen bonds	Nucleotide polymer
C. Starch	Glycosidic bonds	Heteropolymer
D. Inulin	Glycosidic bonds	Homopolymer

1. Only B 2. Only A, C, D
3. Only A,D 4. Only B,D

161. Identify incorrect matching :

List - I Fatty Acids	List - II Carbon Number	List - III Number of Double bonds
A. Arachidic	C_{20}	0
B. Palmitoleic Acid	C_{20}	1
C. Arachidonic Acid	C_{20}	4
D. Palmitic Acid	C_{20}	1

1. Only C 2. Only B
3. Only A 4. Only D

162. Identify the correct matching :

List - I	List - II	List - III
A. Pentoses	$(C_5H_8O_4)n$	Xylans
B. Hexoses	$(C_6H_{10}O_5)n$	Glucans
C. Chitin	Fungal Cellulose	Specialized Compounds
D. Hexoses	Fructans	Inulin

1. ABCD 2. AD
3. BCD 4. Only D

TYPE - V

163. The most abundant elemetns in protoplasm (**Uttarakhand PMT2007;BC Pune 2008**)
1. Nitrogen, carbon, oxygen
2. Carbon, hydrogen, oxygen
3. Carbon, sodium, hydrogen
4. Carbon, phosphorus, hydrogen

164. Secondary metabolite is (**DPMT 2006**)
1. Sugar 2. Glucose
3. Antibiotics 4. All of these

165. The simple polyhydroxy ketone molecule containing 3-7 carbons is a (**Kerala PMT 2006**)
1. Dipeptide 2. Polypeptide
3. Disaccharide 4. Polysaccharide

166. Which one is the sweetest sugar ? (**MPPMT 2007 JIPMER 2008; JAR PMT 2008**)
1. Sucrose 2. Glucose
3. Fructose 4. Maltose

167. Fructose is a/an; (**JKCMEE2006**)
1. Aldohexose 2. Ketohexose
3. ALdopentose 4. Oligosaccharide

168. Example of hexose sugar is
1. Mannose 2. Galactose
3. Arabinose 4. Both 1 and 2 correct

169. Which is a non-reducing sugar (**Orissa JEE 2004**)
1. Glucose 2. Sucrose
3. Galactose 4. Mannose

170. Which of the following is a disaccharide (**RPMT 2002; Orissa JEE 2007**)
1. Glucose 2. Sucrose
3. Galactose 4. Mannose

171. Sucrose, a common table sugar is composed (**PMT 2008**)
1. glucose+fructose
2. glucose+galactose
3. fructose+galactose 4. None of these

172. Which of the following sugar is not found in plant (**JEE-2002**)
1. Sucrose 2. Glucose
3. Lactose 4. Fructose

173. Which sugar is present in milk (**KCET-2010**)
1.Glucose 2. Lactose
3. Cellulose 4. Glycogen

174. The types of linkage present in carbohydrates is (**MPT-2007**)
1. Amide 2. Peptide
3. Glycosidic 4. Phosphate bonds

175. Carbohydrates, the most abundant biomolecules on earth, are produced by (**CBSE-2005**)
1. Some bacteria, algae and green plant cells
2. Fungi, algae and green plant cells
3. All bacteria, fungi and algae
4. Viruses, fungi and bacteria

176. biological membranes consist primarily of two kinds of molecules (**AIPMT-2004**)
1. Carbohydrates and lipids
2. Nucleic acids and proteins
3. Phospholipids and proteins
4. Proteins and carbohydrates

177. Example of a monounsaturated fatty acid is (**PMT-2004**)
1. Oleic acid 2. Palmitic acid
3. Linilenic acid 4. Arrachidonic acid

178. A fatty acid is unsaturated, if it (**AMU-2002**)
1. Contains hydrogen
2. Contains double bond
3. Contains an acidic group
4. One or more double bonds

179. A triglyceride molecule has (**KERALA PMT-2003**)
1. Three fatty acids with two glycerol molecules
2. One fatty acid with one glycerol molecule
3. Three fatty acids with one glycerol molecule
4. Two fatty acids with two glycerol molecule
5. One fatty acid with one glycerol molecule

180. Which of the following is an essential liquid (**AFMC 2001**)
1. Fats 2. Oils
3. Steroids 4. Phospholipid

181. Lipids are insoluble in water because they are (**CBSE-2002**)
1. Neural 2. Hydrophilic
3. Hydrophobic 4. Zwitter ions

182. Phospholipid is (**MANIPAL-2008**)
1. One fatty acid and three glycerol
2. Phosphoric acid, two fatty acid and one glycerol
3. Phosphoric acid, one fatty acid and three glycerol
4. Phosphoric acid, three fatty acids and one glycerol

183. Which of the follwoing is the simplest amino acid (**JIPMER-2007**)
1. Glycine 2. Tyrosine
3. Tyrosine 4. Asparagine

184. Which of the folliwng amino acids is not optically active (**BHU-2005**)
1. Valine 2. Glycine
3. Leucine 4. Isoleucine

185. Which of the following is not an amino acid ? (**AMU-2002**)
1.Lysine 2. Arginine
3. Thymine 4. Tryptophan

186. Which amino acid is required for synthesis of haemoglobin ? (**PBPMT-2000**)
1. Glu 2. His 3. Lys 4. All of these

187. Sugar and amino acids are (**MHCET-2007**)
1. Inoculum 2. Feed stock
3. Primary metabolites
4. Secondary metabolites

188. The differences between one amino acid and another are found in the (**AMU-2002**)
1. R-group 2. Amino agroup
3. Peptide bond 4. Carboxyl group

189. An element playing important role in nitrogen fixation is (**CBSE-2010**)
1. Zinc 2. Copper
3. Manganese 4. Molybdenum

190. Most abundant organic compound in earth is (**CBSE-2001**)
1. Lipid 2. Protein
3. Steroid 4. Cellulose

191. Chemical nature of cellulose is
1. Polypeptide 2. Disacharide
3. Polyncleotide 4. Polysaccharide

192. Chitin is a (**JKCMEE-2007**)
1. Lipid 2. Protein
3. Polysaccharide 4. Sphingomyelin

193. The basic unit of chitin is (**JIPMER-2004**)
1. Glucose 2. Fructose
3. Galactose 4. N-acetyl glucosamine

194. The helical structure of protein is stabilized by (**CBSE-2004**)
1. Glucose 2. Fructose
3. Galactose 4. N-acetyl glucosamine

195. Collagen is a (**PMT-2003**)
1. Lipid 2. Carbohydrate
3. Fibrous protein 4. Globular protein

196. DNA and RNA differ in (**BHU-2003**)
1. N-base and sugars
2. Sugar and phosphate groups
3. Number of C-atoms in sugars
4. N-bases and phosphate groups

197. **Assertion (A)** : Arachidic acid is an unsaturated fatty acid.
Reason (R) : There are present one of more double bonds between carbon atoms in unsaturated fatty acids
(**AIIMS-2007**)

198. Carbohydrates are commonly found as starch in plant storage organs. Which of the following five properteis of starch (A-E) make it useful as a storage material ? (**CBSE-2008**)
A. Easily translocated

B. Chemically non-reactive
C. Easily digested by animals
D. Osmotically inactive
1. A and E 2. B and D
3. B and C 4. A, C and E

199. Molecules that bear charged groups of opposite polarity are knowns as (**DUMAT-2007**)
1. Cations 2. Anions
3. Zwitterions 4. Negative ions

200. Excess carbohydrates and proteins are stored in the body as (**DUMET-2010**)
1. Fats 2. Starch
3. Amino acids 4. Monosaccharide

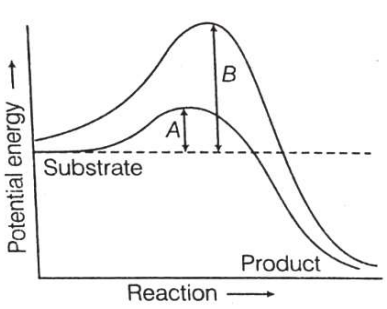
201. Which of the followng biomolecules does have a phosphodiester bond **[CBSE Aipmt - 2015]**
1) fatty acids in a diglyceride
2) monosaccharides in a polysaccharide
3) amino acids in a polypeptide
4) nucleic acids in a nucleotide

202. The chitinous exoskeleton of arthropods is formed by the polymerisation of **[CBSE Aipmt - 2015]**
1) keratin sulphate and chondroitin sulphate
2) D-glucosamine
3) N-acetyl glucosamine
4) ipoglycans

203. A non-proteinaceous enzyme is **[Neet - 2016, Phase-2]**
1) lysozyme 2) ribozyme
3) ligase 4) deoxyribonuclease

204. Which of the following is the least likely to be involved in stabilising the three-dimensional folding of most proteins **[Neet - 2016, Phase-2]**
1) hydrogen bonds
2) electrostatic interation
3) hydrophobic interaction
4) ester bonds

205. Which of the follwoing describes the given graph correctly **[Neet - 2016, Phase-2]**



1) endothermic reaction with energy A in the presence of enzyme and B in the absence of enzyme
2) exothermic reaction with energy A in the presence of enzyme and B in the absence of enzyme
3) Endothermic reaction with energy A in the absence of enzyme and B in the presence of enzyme
4) Exothermic reaction with energy A in the absence of enzyme and B in the presence of enzyme

206. Which one of the following statements is wrong **[Neet - 2016, Phase-1]**
1) cellulose is a polysaccharide
2) uracil is a pyrimidine
3) glycine is a sulphur containing amino acid
4) sucrose is a disaccharide

207. A typical fat molecules is made up of **[Neet - 2016, Phase-1]**
1) one glycerol and three fatty acid molecules
2) one glycerol and one fatty acid molecule
3) three glycerol and three fatty acid molecules
4) three glycerol molecules and one fatty acid molecule

208. Which of the following are not polymeric **[Neet - 2017]**
1) nucleic acid 2) proteins
3) polysaccharides 4) lipids

209. Which one of the following statements is correct, with reference to enzymes **[Neet - 2017]**
1) apoenzyme = holoenzyme + coenzyme
2) holoenzyme = apoenzyme + coenzyme
3) coenzyme = apoenzyme + holoenzyme

4) holoenzyme = coenzyme + cofactor

210. The two functional groups characteristic of sugars are **[NEET - 2018]**
1) hydroxyl and methyl
2) carbonyl and methyl
3) carbonyl and phosphate
4) carbonyl and hydroxyl

211. Which of the following glucose transporters is insulin - dependent **[NEET - 2019]**
1) GLUT IV 2) GLUT I
3) GLUT II 4) GLUT III

212. Consider the following statements **[NEET - 2019]**
A) Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group
B) A complete catalytic active enzyme with its bound prosthetic group is called apoenzyme
Select the correct option
1) A is false but B is true
2) both A and B are true
3) A is true but B is false
4) both A and B are false

213. Concanavalin A is **[NEET - 2019]**
1) a pigment 2) an alkaloid
3) an essential oil 4) a lectin

214. "Ramachandran plot" is used to confirm the structure of **[NEET - 2019]**
1) RNA 2) proteins
3) triacylglycerides 4) DNA

215. Prosthetic groups differ from co-enzymes in that **[Odisha NEET - 2019]**
1) they require metal ions for their activity
2) they (prosthetic groups) are tightly bound to apoenzymes
3) their association with apoenzymes is transient
4) they can serve as co-factors in a number of enzyme-catalyzed reactions

216. Which of the following organic compounds is the main constituent of lecithin **[Odisha NEET - 2019]**
1) arachidonic acid 2) phospholipid
3) cholesterol 4) phosphoprotein

CH:10 - BIOMOLECULES

MODEL TEST - I

1. 1 2. 2 3.3 4. 4 5.4
6.3 7.2 8.2 9. 1 10.3
11.3 12.1 13.1 14.4 15.3
16.3 17.3

MODEL TEST - II

18) 3 19) 1 20) 2 21) 4 22) 4
23) 2 24) 1 25) 2 26) 1 27) 4

QUESTION BANK

TYPE - I

1) 3 2) 4 3) 2 4) 3 5) 4
6) 4 7) 1 8) 4 9) 3 10) 4
11) 3 12) 2 13) 4 14) 4 15) 4
16) 3 17) 2 18) 1 19) 1 20) 4
21) 4 22) 3 23) 4 24) 2 25) 2
26) 3 27) 2 28) 4 29) 3 30) 2
31) 4 32) 1 33) 2 34) 2 35) 2
36) 4 37) 2 38) 4 39) 3 40) 3
41) 3 42) 2 43) 3 44) 3 45) 3
46) 2 47) 1 48) 2 49) 3 50) 4
51) 2 52) 4 53) 4 54) 2 55) 3
56) 4 57) 4 58) 2 59) 4 60) 4
61) 2 62) 1 63) 2 64) 1 65) 4
66) 2 67) 2 68) 3 69) 2 70) 3
71) 2 72) 3 73) 3 74) 3 75) 1
76) 2 77) 3 78) 1 79) 4 80) 4
81) 2 82) 1 83) 2 84) 3 85) 1
86) 4 87) 3 88) 3 89) 3 90) 1
91) 3 92) 1 93) 3 94) 3 95) 2
96) 3 97) 2 98) 2 99) 1 100) 2
101) 2 102) 1 103) 1 104) 4 105) 3
106) 1 107) 3 108) 4 109) 2 110) 2
111) 1 112) 2 113) 1 114) 1 115) 2
116) 1 117) 3 118) 3 119) 4 120) 1
121) 1 122) 3 123) 3 124) 1

TYPE - II

125) 3 126) 4 127) 4 128) 4 129) 4
130) 4 131) 4 132) 2 133) 4 134) 3
135) 3 136) 4 137) 4 138) 2 139) 3
140) 3 141) 1 142) 3 143) 4 144) 3
145) 4 146) 4

TYPE - III

147) 1 148) 2 149) 1 150) 1 151) 4
152) 4 153) 2 154) 4 155) 4 156) 3
157) 4

TYPE - IV

158) 1 159) 3 160) 2 161) 4 162) 1

TYPE - V

163) 2 164) 3 165) 3 166) 3 167) 2
168) 4 169) 2 170) 2 171) 1 172) 1
173) 2 174) 3 175) 1 176) 3 177) 2
178) 2 179) 3 180) 2 181) 3 182) 2
183) 1 184) 2 185) 3 186) 2 187) 3
188) 1 189) 4 190) 4 191) 4 192) 3
193) 4 194) 4 195) 3 196) 1 197) 4
198) 2 199) 3 200) 1 201) 4 202) 2
203) 2 204) 4 205) 2 206) 3 207) 1
208) 4 209) 2 210) 4 211) 1 212) 4
213) 4 214) 2 215) 2 216) 2

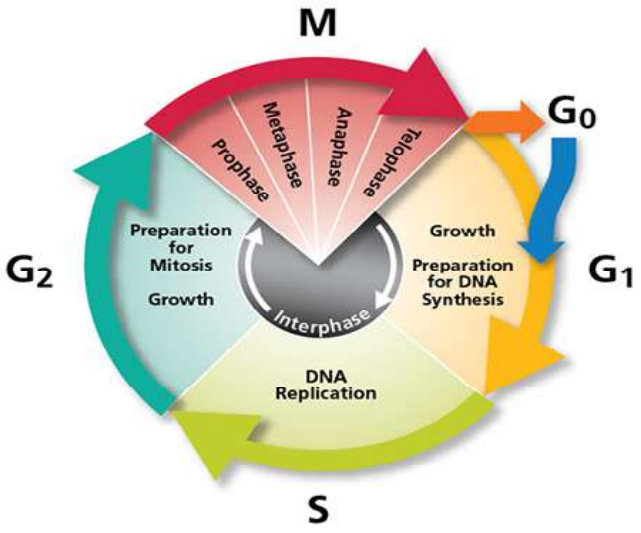
CH-11 : CELL CYCLE AND CELL DIVISION

SYNOPSIS

- All the organisms including the largest plant and the largest animal start their life from a single cell.
- Growth and reproduction are characters or features of cells and the living.
- Plants and animals do grow by cell division , cell elongation and cell differentiation but not in all their parts and all their life.All cells in a plant do not divide all the time but meristematic cells divide all through their life in higher plants.They are located at growing region i.e root tip and shootip.All nucleated living plant cells under defined conditions regain the power of division. Animals do not have meristematic tissues.
- All cells reproduce by division. Each parent cell divides to form two daughter cells. Hence cells double by every division. If ' n' is number of divisions n-1 is total divisions.
- Newly formed cells grow and divide again and form cell population.ie..group of cells derived from a single parent cell.
- Growth and division cycles make a single cell to form a structure made of millions of cells.

CELL CYCLE

- DNA replication and cell growth takes place during cell division.
- The total genetic material or haploid set of chromosomes of a species is called genome.
- The coordination of cell growth,DNA replication and cell division results in progeny or daughter cells containing intact genome.
- The sequence of events by which a cell duplicates its genome ,synthesises the other constituents of the cells and eventually divides to form two daughter cells is termed as cell cycle.
- Cell growth is a continuous process but DNA synthesis is confined to a single stage.[S]
- The replicated chromosomes [DNA] are then distributed to daughter nuclei by a series of events [Prophase to Telophase] during division which are under genetic control.
- Human cell in culture is typically eukaryotic and divides approximately once in 24 hours.
- The time required for one division is called generation time. It is 90 minutes in Yeast



PHASES OF CELL CYCLE

- The cell cycle is divided into inter phase and division phase or mitotic phase.In the former the cell spends 95% of the time and in the later one hour of the 24hrs average duration of cell cycle.
- The 'M' phase starts by karyokinesis [nuclear division] and ends by cytokinesis [cytoplasmic division].

INTERPHASE

- The cell prepares for division in interphase by growth and DNA replication.As there is no actual division of cell this is called resting phase or non apparent division phase.
- G_1,S, and G_2 are the three stages of interphase.
- Interval between mitosis and DNA replication is called interphase.
- Active metabolism, continuous growth and DNA synthesis are features of interphase.
- Time period between $G_1$and G_2 is called 's'or synthetic phase.

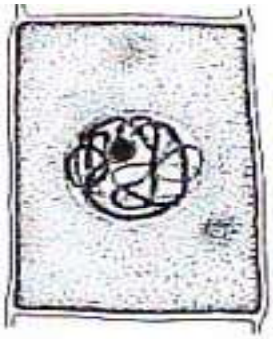
- Synthesis of DNA ie 2cDNA increase to 4c DNA,no increase in chromosome number ,no change in percentage of nucleotides,unaltered ploidy are the characters of 's' phase.
- Start of DNA replication in nucleus and centrioles duplication in cytoplasm occur simultaneously in animal cells.
- In adult animals many cells do not appear to show division but they divide to replace dead or injured cells only.The cells that do not divide exit from G_1 and enter G_0 stage and remain metabolically active but divide when required by the organism.
- In animals diploid somatic cells only divide but in plants both diploid [root tip,shootip etc;] and haploid cells[microspore and megaspore higher plants and all cells in Spirogyra] divide in the life cycle.Gamete formation in gametophyte and sporophyte formation from zygote takes place by mitosis.

M-PHASE

- In 'M' phase or mitotic phase chromosome number does not change in daughter cells so it is also called equational division.
- Onion root tip cell[2n]contains 14 chromosomes .The same number occurs in G_1,S,G_2, Pand M stages. In anaphase the chromosome number equals to 4n.
- When DNA content of root tip cell after 'M' phase is 2c the DNA content is 2c in G_1 4c after 'S' and G_2).

PROPHASE

- It occurs after 'S' and G_2 phases.
- Each chromosome contains two chromosomes.
- .Initiation of spindle takes place.
- .Duplicated centrioles move to opposite poles.
- . E.R,Golgi complex, Nucleolii, Nuclear envelope are absent



Prophase

METAPHASE.

- . Morphology of chromosomes is easily studied due to completion of condensation.
- .In the initial stages chromosomes are scattered due to complete disintegration of nuclearmembrane.
- Each chromosome contains two sister chromatids attached at one centromere which has kinetochore on either side.
- Kinetochores are sites of attachment of spindlefibres.
- The chromosomes attached to spindle fibres move to the centre of the cell and form equitorialplate.
- The plane of alignment of the chromosomes at metaphase with centromeres of all of them in one line is called eqitorialplate. This is a key feature of the stage.
- In each chromosome at equatorial plate, one chromatid is connected by its kinetochore to spindle fibres from one pole and its sister chromatid is connected by its kinetochore to spindlefibre from opposite pole.

Metaphase

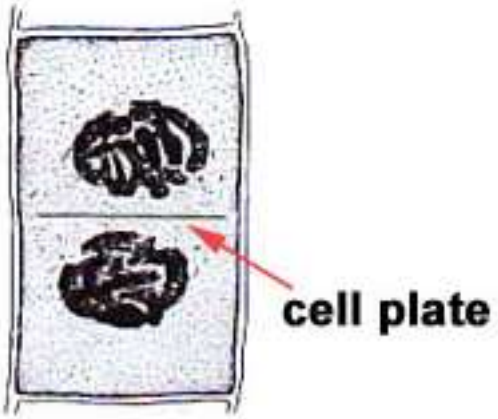
ANAPHASE

- The centromere of chromosome splits and chromatids separate and move to opposite poles.
- The chromatids are now called chromosomes.
- The cell contains double the number of chromosomes.
- The centromere of chromosomes is towards poles and arms are towards equator.

Anaphase

TELOPHASE

- Chromosomes at respective poles decondense and loose their individuality and tend to collect in a mass.
- Nuclear envelope assembly occurs around chromosomes.
- Nucleus ,Golgicomplex and Endoplasmic reticulum reappear.

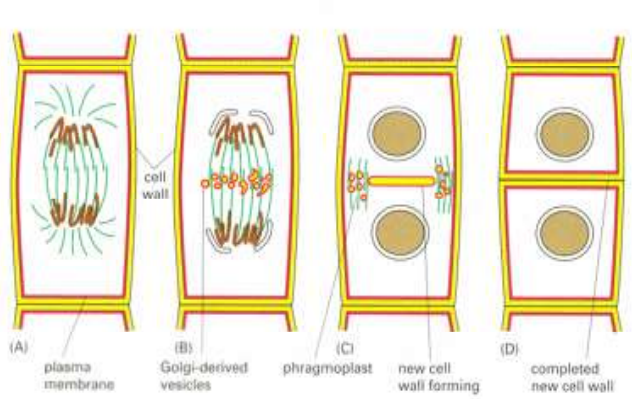


Telophase

CYTOKINESIS

- Division of cytoplasm into daughter cells is called cytokinesis.
- In animal cell daughter cells arise by a furrow and its deepening in the plasmamembrane.
- In plants cytokinesis takes place by cellplate method because plant cell is covered by Cellwall.
- Cellplate is the starting structure of cellwall and it represents middlelamella.
- Cellplate arises at the centre of cell and it forms cellwall by centrifugal growth.
- E.R and Golgicomplex play role in cellwall formation.
- The cytokinesis ends by distribution of cell organells between daughter cells.

CH-11 : CELL CYCLE AND CELL DIVISION



Free nucelar division

- No cytokinesis after karyokinesis leads to freenuclear condition or Syncytium.
  Eg; Liquid endosperm of coconut and initial stages of embryosac development

Significane of Mitosis

- It causes growth in multicellular organisms.So it occurs usually in the development of diploid plant or animal from zygote. Some times it occurs in the development of haploid body in organisms.Eg;Gametophyte development in plants from spore and haploid insects from gametes. Eg;Male honey-bee.
- It restores the nucleocytoplasmic ratio disturbed by growth of cell.
- It maintains identical genetic complement in all the body cells either haploid or diploid because all the cells derived by mitosis have same number and types of chromosomes.
- In cell repair it replaces aged or injured cells. So has a role in wear and tear and wound healing process.EgConstant replacement of cells in the gut and bloodcells.
- It occurs in apical and lateral meristems in plants and continues growth.

MEIOSIS

- The body of organisms is diploid. It contains specilized cells for reproduction.
- The specilized diploid reproductive cells undergo division that reduces chromosome number by half and results in haploid gametes.
- This division in which diploid (sporophytic) cells with two sets of chromosomes form haploid (gametophytic) cells with one set of chromosomes is called reduction division or Meiosis.
- The haploid gametes by fertilization or union of gametes form diploid zygote. Hence Meiosis converts sporophytic phase to gametophytic phase and fetilization gets back spophytic phase.
- Meiosis occurs during gametogenesis in plants and animals.
- Meiosis involves two cycles of karyokinesis and cytokinesis accompanied by one time DNA replication and one time division of centromere. The two cycles are designated as Meiosis and Meiosis-II
- Meiosis-I begins by replication of chromosome into two sister chromatids at 'S' phase after DNA replication.
- Meiois involves pairing of homologous chromosomes or synopsis and crossing over leading to genetic recombinations.
- Four haploid cells are formed from one mother cell.
- The cell undergoing meiosis is called Meiocyte.

MEIOSIS-I (Heterotypic division)

- Longer and complex phase.
- Leptotene, Zygotene, Pachytene, Diplotene, Diakinesis are its phases.
- Results in two haploid daughter cell from a diploid cell so reduction division.

.

LEPTOTENE

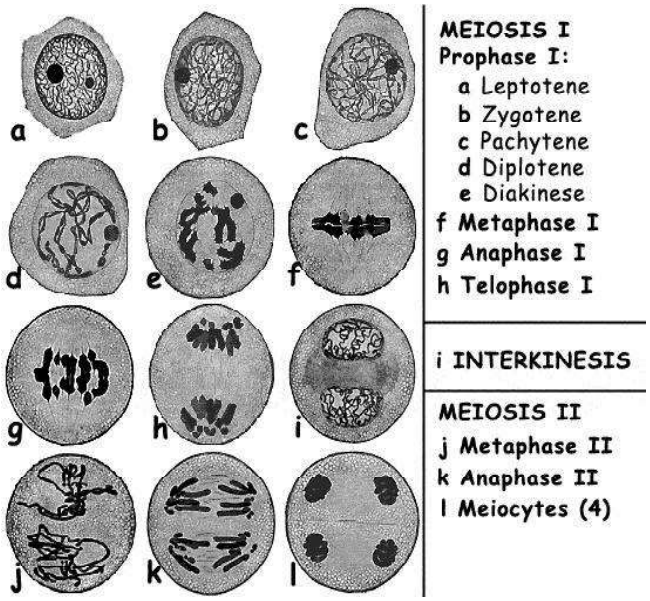
- Neat packing of chromosomes continues thoughtout the phase.
- Chromosomes become visible under microscope.

ZYGOTENE

- Pairing of homologous chromosomes or synapsis takes place.
- Each pair is called bivalent and their number equals to haploid number.
- Synapsis involves formation of synaptenimal

complex.

- Each chromosome contains two chromatids hence bivalent is called tetrad (four strand stage).



PACHYTENE

- Prolonged stage.
- Bivalents clearly appear as tetrads.
- Exchange of genetic material takes place between nonsister chromatids and this is called crossing over.
- Besides centromeres non sister chromatids are linked or attached at chiasma.

DEPLOTENE

- Repulsion leads to breakage or dissolution of synaptonemal complex.
- Homologous chromosomes of the bivalents separate from each other but attached at sites of crossing over.
- In oocytes of vertebrates this stage lasts for months or years.

DIAKINESIS

- Final stage.
- Terminalization takes place.
- The sliding of chiasma to ends of chromasomes is called terminalization.
- The condensation of chromosomes completes.
- The nucleous and nuclear membrane disappear.

METAPHASE-I

- The bivalents align on equatorial plate (chromosomal congression).
- Microtubules from opposite poles of the spindle attach to the pair of homologous chromosomes.

ANAPHASE-I

- No division of centromere.
- Homologous chromosomes are pulled to opposite poles (Disjunction).
- The sister chromatids remain attached to centromere.
- Chromosome number at each pole is half that of parent cell.

TELOPHASE-I

- Nuclear membrane and nucleolus reappear. Two daughter nuclei occur in the mother cell.
- Cytokinesis separates two daughter cells. This is called diad of cells. They are haploid (n).

INTERKINESIS

- It is the stage between two nucelar divisions.
- DNA is not synthesized in this stage.
- It is short lived.
- Though chromosomes uncoil and show dispersion yet it is not like the complete disperson observed in Interphase.
- It is followed by simpler phrophase-I.

MEIOSIS-II (Homeotypic division)

- This is equational division.
- It occurs in two daughter nuceli.
- Two spindles are formed in this stage.

PROPHASE-II

- It occurs after division of cytoplasm and usually before complete elongation of chromosome.
- Nuclear membrane disappears and changes are similar to Mitosis.

METAPHASE-II

- Chromosomes arrange at the equatiorial plate.

- Microtubules of opposite poles attach to kinetochores of sister chromatids.

ANAPHASE-II

- The centromere of each chromosome splits and sister chromatids move to opposite poles.

TELOPHASE-II

- Nuclear membrane, nucleolus reappear and decondensation of chromosomes takes place. Four haploid nuclei appear.

CYTOKINESIS

- Division of cytoplasm results in four haploid cells. This is called tetrad.

Significance

- It protects same chromosome number accross generations in sexually reproducing organisms.
- It maintains one set of chromosomes in gametes.
- It increases genetic variability an account of crossing over leading to recombinations which lead to variations helpful for evolution.

CHROMOSOME NUMBERS IN MEIOCYTES (DIPLOID, 2N) AND GAMETES (HAPLOID, N) OF SOME ORGANISMS.

Organism	Chromosome number in meiocyte(2n)	Chromosome number in gamete(n)
Human beings	46	23
House fly	12	6
Rat	42	21
Dog	78	39
Cat	38	19
Fruit fly	8	4
Ophioglossum (a fern)	1260	630
Apple	34	17
Rice	24	12
Maize	20	10
Potato	48	24
Butterfly	380	190
Onion	16	8
Haplopappus gracilis	4	2

MODEL TEST - I

1. Cells dividing all through their life are present in
   1) Parenchyma 2) Collenchyma
   3) Meristem 4) Complex tissues
2. Meristems are located at/in
   1) Node and internode
   2) Stem tip and root tip
   3) Fruit and seed
   4) Bract and scale leaf
3. Enucleated living cell cannot show
   1) Cell divison 2) de-differentiation
   3) Re-diffirentiation 4) All the above
4. A population of cells develop from
   1) two cells 2) single cell
   3) many cells 4) five cells
5. Cell division includes
   1) Both DNA replication and growth of cell
   2) Growth of cell but no DNA replication
   3) DNA replication but no growth of cell
   4) Neither DNA replication nor growth of cell
6. The haplod set of chromosomes represents
   1) Gene 2) Genome
   3) Germ plasm 4) Idiogram
7. The sequence of events by which a cell grows, duplicates its genome and divides into two daughter cells is called
   1) Interphase 2) Division phase
   3) Cell cycle 4) Cell growth
8. Time required by human cells in cutlure and yeast cells for one division respectively
   1) 24 hrs and $1\frac{1}{2}$ hrs
   2) $1\frac{1}{2}$ hrs and 24 hrs
   3) 9 minutes and 24 hrs
   4) 24 hrs and 2 hours
9. Division of nucleus is called
   1) Amitosis 2) Karyokinesis
   3) Cytokinesis 4) Mitosis
10. If Adenine is 10% in G_1 phase the percentage of the same in S phase
    1) 20% 2) 40%
    3) 10% 4) 30%

11 The sequence of stages in interphase
1) G_1, S, G_2 2) G_2, S, G_1
3) G_1, G_2, S 4) S, G_1, G_2

12 Centrioles duplication doesnot occur in
1) Animal cells 2) Plant cells
3) Protozoans 4) All eukaryotic cells

13 G_0 stage derived when cell with draws from
1) S stage 2) G_2 stage
3) G_1 stage 4) M phase

14 Mitosis does not occur in
1) Animals 2) Plants
3) Prokaryotes 4) Protozoans

15. Haploid vegetative cells divide in
1) Chlorella 2) Chlamydomonas
3) Spirogyra 4) Fucus

16. If a parent cell contains 20 chormosomes daughter cells derived from it contain how many chromosomes each?
1) 40 2) 60
3) 20 4) 10

17. 2C DNA becomes 4C in
1) G_1 2) G_0 3) S 4) G_2

18. Replication of DNA enzymes are active in
1) G_1 2) G_0
3) S 4) G_2

19. If 6000 nucleotides are in G_1 phase number of nucleotides in S phase
1) 1200 2) 12000
3) 6000 4) 9000

20. In adult animals cells divide for
1) Growth 2) replacement of cells
3) cell elongation
4) increasing DNA content

MODEL TEST - II

21. Shortest phase in cell cycle
1) S 2) G_1
3) G_2 4) M phase

22. How many chromatids are present in a chromosome in prophase
1) 1 2) 2 3) 4 4) 8

23. In animal cells duplication of centriole and movement of them to opposite poles take place respectively in
1) S phase and prophase
2) S phase and metaphase
3) Anaphase and prophase
4) Metaphase and anaphase

24. Number of chromomsomes in G_1 phase, after S phase and M phase upto metaphase in onion root tip cell respectively
1) 16,16,24 2) 16,16,16
3) 16,16,32 4) 12,16,32

25. What phase comes after G_2
1) Prophase 2) Metaphase
3) Anaphase 4) Telophase

26. Chromosomal material condensation begins in
1) Metaphase 2) Prophase
3) Anaphase 4) Telophase

27. Initiation of assembly of mitotic spindle takes place is
1) Metaphase 2) Anaphase
3) Telophase 4) Prophase

28. Which of the following is seen at the end of prophase
1) Golgi complex
2) Endoplasmic reticulum
3) Nucleolus
4) Cell membrane

29. Chromosomes in the beginning of metaphase are scattered in the cell because
1) Cell organelles are absent
2) Nuclear envelop is absent
3) Cell membrane is absent
4) Ribosomes are absent

30. Sites of attachment of spindle fibres
1) Kinetochore 2) Centromere
3) Telomere 4) Arms

31. Condensation of chromosomes complete in
1) Prophase 2) Metaphase
3) Anaphase 4) Telophase

32. Number of chromatids of Allium seen in metaphase of onion root tip cell
1) 16 2) 32
3) 64 4) 96

33. Metaphase is characterised by
1) Equitorial plate
2) Two chromatids in a chromosome
3) Two centromeres in each chromosome
4) Two kinetochores in each chromatid

34. Chromosomes move centripetally during
1) Prophase 2) Metaphase
3) Anaphase 4) Telophase

35. Centromere divides during
1) Interphase 2) S phase
3) Anaphase 4) Telophase

36. Chromosomes move to the poles in
1) Prophase 2) Anaphase
3) Interphase 4) Interkinesis

37. Chromosome identity is lost during
1) Prophase 2) Metaphase
3) Anaphase 4) Telophase

38. Changes are opposite to prophase in
1) Anaphase 2) Telophase
3) Interphase 4) Metaphase

39. Precurssor of cell wall
1) Cell plate 2) Spindle
3) Centriole 4) Centrosome

40. Syncytium arises due to
1) No karyokinesis 2) No cytokinesis
3) No spindle formation
4) No protoplasm

41. Genetic compliment identical to parent is obtained by
1) Meiosis 2) Mitosis
3) both meiosis and mitosis
4) Free nucelar division only

42. Growth disturbs the ratio between
1) Cell wall and protoplasm
2) Nucleus and protoplasm
3) Nucleus and cytoplasm
4) Cell organelles to cytoplasm

MODEL TEST - III

43. The type of cell division reducing the chromosome number by half
1) Amitosis 2) Mitosis
3) Meiosis 4) Somatic division

44. Meiosis occurs in
1) All types of cells 2) Diploid somatic cell
3) Haploid reproductive cell
4) Diploid reproductive cell

45. Zygote arises by
1) Mitosis 2) Meiosis
3) Somatogamy 4) Fertilization

46. Meiosis converts
1) Gametophyte to gametophyte
2) Sporophyte to gametophyte
3) Gametophyte to sporophyte
4) Vegetative cell to reproductive cells

47. Meiosis involves
1) two cycles of karyokinesis and two cycles of cytokinesis
2) two cycles of karyokinesis and one cycle of cytokinesis
3) one cycle of karyokinesis and two cycles of cytokinesis
4) two cycles of karyokinesis and two times division of centromere

48. How many times does DNA replicate in the two cycle of karyokinesis in meiosis?
1) 1 2) 2
3) 3 4) 4

49. In meiosis chromosomes replicate in
1) Prophase 2) Anaphase
3) S phase 4) Telophase

50. Sister chromatids in meiosis occur first in
1) Leptotene 2) Zygotene
3) Pachytene 4) Interphase

51. Which one of the following does not occur in meiosis?
1) Synapsis 2) Chiasma
3) Recombination of genes
4) Somatogamy

52. Number of cells formed from one mother in Meiosis
1) 2 2) 4
3) 6 4) 8

53. Cell undergoing meiosis is called
1) Coenocyte 2) Syncytium
3) Meiocyte 4) Collocyte

54. Two haploid cells in Meiosis arise after
1) Meiosis-I 2) Telophase-I
3) Anaphase-I 4) Prophase-I

55. Synapsis occurs during
1) Leptotene 2) Zygotene
3) Pachytene 4) Deplotene

56. Synapsis occurs between
1) Homoglous chromosomes
2) Non homologous chromosomes
3) Both homologous and non homologous chromosomes
4) Sex chromosomes only

57. Tetrad contains how many chromatids?
1) 2 2) 4
3) 6 4) 8

58. Synaptinemal complex appears in
1) Leptotene 2) Zygotene
3) Pachytene 4) Deplotene

59. Largest subphase
1) M phase 2) Leptotene
3) Pachytene 4) Deplotene

60. Crossing over results in
1) Parental combinations
2) Recombinations
3) Mutation 4) Abressions

61. Synaptenimal complex breaks in
1) Zygotene 2) Meiosis-II
3) Deplotene 4) Pachytene

62. Which is the stage that lasts for months and years in vertebrates oocytes?
1) Leptotene 2) Zygotene
3) Pachytene 4) Deplotene

63. Terminalization is a feature of
1) Zygotene 2) Pachytene
3) Diakinesis 4) Leptotene

64. Completion of condensation of chromosomes, breakdown of nuclear membrane, spindle initiation are characters of
1) Metaphase-II 2) Anaphase-I
3) Diakinesis 4) Deplotene

MODEL TEST - IV

65. Centromere doesnot divide in
1) Mitosis 2) Meiosis-I
3) Meiosis-II 4) Somatic division

66. Chromosome number appears to be reduced to half for the first time in
1) Prophase-I 2) Metaphase-I
3) Anaphase-II 4) Anaphase-I

67. Meiosis-II
1) Equational division 2) Reduction division
3) Amitosis 4) Endomitosis

68. Genetic variability is increased by
1) Somatic division 2) Mitotis
3) Amitosis 4) Reduction division

69. Prophase-II occurs in howmany cells?
1) 1 2) 2 3) 4 4) 3

70. Homologous chromosomes move to opposite poles in
1) Metaphase-I 2) Anaphase-I
3) Metaphase-II 4) Anaphase-II

71. How many spindles occur in Meiosis?
1) 1 2) 2
3) 3 4) 4

72. Four haploid nuclei occur at the end of
1) Prophase-I 2) Anaphase-I
3) Telophase-II 4) Anaphase-II

73. Sister chromatids move to opposite poles in
1) Prophase 2) Metaphase-II
3) Anaphase-II 4) Telophase

74. Centromere divides in
1) Anaphase - I 2) Anaphase-II
3) Metaphase-I 4) Metaphase-II

75. Same chromosome number accross generations is maintained by
1) Mitosis 2) Meiosis
3) Somatic division
4) Equational division.

QUESTION BANK
TYPE – I

76. How many generations of equational divisions are necessary in a cell of onion root tip to form 128 cells?
1) 64 2) 128
3) 7 4) 127

77 Cells in G_0 phase of cell cycle:
1) Suspend cell cycle 2) Enter cell cycle
3) Exit cell cycle 4) Terminate cell cycle

78. If one cell has twice as much DNA as another similar cell, the most probable is that:
1) It is secreting 2) It is dividing
3) it is respiring 4) It is moving

79. The stage of mitosis in which nucleolus and nuclear membrane disappear and chromosomes become distinct is:
1) Prophase 2) Anaphase
3) Telophase 4) Interphase

CH-11 : CELL CYCLE AND CELL DIVISION

80. The growth of multicellular organisms takes place by
1) Cell division 2) Cell elongation
3) Cell differentiation
4) The combination of 1,2,3

81. Cell division in the organisms result in the
1) Growth of the organisms being stopped
2) Increase in the number of cells
3) Death of the cells
4) Fusion of cells with one another

82. In multicellular organisms all the cells present in the body of organism divide by
1) One type of cell division
2) Different types of cell division
3) Cannot say 4) Meiosis only

83. The intermediate period present between the two division phases is called
1) Prophase 2) Telophase
3) Interphase 4) Metaphase

84. In cell cycle new cell organelles are formed in
1) Prophase 2) Telophase
3) Anaphase 4) Interphase

85. How many sub phases are present in Interphase
1) 4 2) 3
3) 2 4) 1

86. In the cell cycle
1) Interphase is followed by division phase
2) division phase is followed by Interphase
3) Interphase, division phase both start at a time
4) Interphase, division phase alternate with each other

87. DNA is duplicated in
1) G-I phase 2) S-Phase
3) G-II phase
4) G-I and G-II phases

88. Histone proteins are not synthesized in
1) G_1 phase 2) S– phase
3) G_2 phase 3) $G_1 – G_2$

89. The sequence of events in a cell cycle
1) $S–G_1–G_2–M$ 2) $S–M–G_1–G_2$
3) $G_1–S–G_2–M$ 4) $M–G_1–G_2–S$

90. The best region to observe mitosis in plants
1) Anther 2) Root apex
3) Stem 4) Embryo

91. In Prophase of Mitosis, these are formed
1) Centromere 2) Chromatids
3) Centromere & Chromatids
4) Daughter chromosomes

92. Nuclear envelope and nucleolus disappear during
1) Telophase 2) Metaphase
3) Prophase 4) Anaphase

93. In Metaphasic plate
1) Chromatids of the chromosomes are arranged in one line
2) Centromeres of the chromosomes are arranged in one line
3) Chromatids and centromeres of the chromosomes are arranged in one line
4) Centromeres of the chromosomes float in the cytoplasm freely

94. Ideal stage for counting chromosomes in mitosis is
1) Metaphase 2) Zygotene
3) Diplotene 4) Diakinasis

95. The region of chromosomes to which spindle fibres are attached
1) Centriole 2) Chromosomes
3) Kinetocore 4) Chromocentre

96. In metaphase chromosomes are arranged on metaphasic plate with the help of
1) Cytoskeleton 2) Spindle fibres
3) Nucleus
4) Chromosomes are arranged automatically on cell plate

97. During Anaphase, movement of daughter chromosomes towards the poles is due to
1) Pressure developed in the centromere
2) Contraction of spindle fibres
3) Repulsion between the chromosomes
4) Contraction of chromatid arms

98. In Anaphase, the chromosomes attain different shapes. It is due to the
1) Contraction of spindle fibres
2) Pressure developed in the centromere
3) Position of centromere
4) Movement of chromosomes towards the poles

99. The number of chromatids present in a chromosome during anaphase of mitosis
1) 1 2) 2
3) 4 4) Many

100. Division of centromere and movement of daughter chromosomes to opposite poles occur during
1) Prophase 2) Telophase
3) Metaphase 4) Anaphase

CH-11 : CELL CYCLE AND CELL DIVISION

101. Duplicated chromosomes tend to travel to the poles in
1) Anaphase 2) telophase
3) Metaphase 4) Prophase

102. The movement of chromosomes is
1) Independent of spindle fibres
2) Dependent upon the association of spindle fibres
3) Due to cytoplasmic streaming
4) Due to excess of ATP generated by mitochondria

103. During mitosis, metaphase differs from anaphase in having
1) Same number of chromosomes, half number of chromatids
2) Half number of chromosomes, half number of chromatids
3) Half number of chromosomes, same number of chromatids
4) Same number of chromosomesand double the number of chromatids

104. Pick out the wrong pair
1) Anaphase-division of centromere
2) Metaphase-chromosomes clearly appear
3) Prophase-Spiralization
4) Telophase-chromosomes becomes thin, long

105. How many mitotic divisions occur in a cell of root tip to form 256 cells
1) 8 2) 64
3) 255 4) 128

106. Number of mitotic cell divisions for formation of 2 cells
1) One 2) Two
3) Infinite 4) Three

107 Which division maintains genetic simililarity
1) Mitosis 2) Meiosis
3) Amitosis 4) Reduction division

108. In which stage of cell division, number of chromosomes are best counted?
1) Prophase 2) Metaphase
3) Telophase 4) Interphase

109. In which order, cytokinesis occurs in plants?
1) Centripetal 2) Centrifugal
3) Oblique 4) Equatorial

110. How many chromosome shall be present in a diploid cell at mitotic anaphase if its egg cell has ten chromosome?
1) 10 (Ten) 2) 20 (Twenty)
3) 30 (Thirty) 4) 40 (Forty

111. Genetic information is transferred from zygote to all body cell by
1) Meiosis 2) Amitosis
3) Endomitosis 4) Mitosis

112. If you are provided with root-tips of onion in your class and are asked to count the chromosomes, which of the following stages can you most conveniently look into
1) Telophase 2) Anaphase
3) Prophase 4) Metaphase

TYPE - II

113. During meiosis reduction of chromosome number into half takes place in which of the following stages?
1) Prophase I 2) Anaphase I
3) Metaphase I 4) Metaphase II

114 In angiosperms, meiosis occurs at the time of:
1) Bud formation
2) Formation of male and female gamete
3) Pollen grains or microspore formation
4) seed germination

115 Crossing over is advantageous because it brings about:
1) Variation 2) Linkage
3) Inbreeding 4) Stability

116. A cell undergoing meiosis is known as:
1) Androcyte 2) Zygote
3) Meiocyte 4) Zoospore

117. Zygotic meiosis is the feature of:
1) Capsella 2) Spirogyra
3) Fern 4) Angiosperms

118. Homologous chromosomes:
1) Are from different mating parents
2) Are from same parent
3) Form pair during mitosis
4) Exhibit cross over at anaphase

119. Daughter cells formed as a result of meiosis are not similar to that of the parent cell because:
1) Crossing over occurs and number of chromosomes becomes half
2) Prophase is large
3) There are two divisions
4) Synapsis occurs

120. The number of chromosome pairs at diakinesis in a meiocyte is 12, the chromosome number expected in each nucleus after first and second cycle of division could respectively be:
1) 12 and 6 2) 12 and 12
3) 6 and 12 4) 24 and 12

121. The chromosome number of Maize is 20. What must occur to maintain same chromosome number in the next generation after sexual reproduction
1) Mitosis 2) Meiosis
3) Amitosis 4) Duplication of cells

122. In a seed plant reductional division occurs in the
1) Roots 2) Leaves
3) Seeds
4) Anthers and Ovules

123. The process that ensure the maintenance of constant number of chromosomes from generation to generation in a species is
1) Mitosis 2) Meiosis
3) Endomitosis 4) Amitosis

124. In angiosperms, the meiotic division takes place in
1) Apical meristem 2) Intercalary meristem
3) Spore mother cells 4) Endosperm

125. In bivalent
1) a pair of non-sister chromatids are present
2) 2 pair of non-sister chromatids are present
3) 3 pair of non-sister chromatids are present
4) 4 pair of non-sister chromatids are present

126. Synapsis is characteristic of
1) Leptotene 2) Pachytene
3) Zygotene 4) Diplotene

127. Synapsis is the pairing of
1) Analogous chromosomes
2) Homologous chromosomes
3) Acentric chromosomes
4) Non homologous chromosomes

128. Each chromosomal pair has a distinct morphology with regard to
1) Relative length of arms and position of centromere
2) Relative length of chromosomes but the position of the centromere does not matter
3) Position of centromere but length of the chromosome is not important
4) The number of active genes present there

129. In meiosis tetrads of chromatids are found in
1) Prophase-I 2) Prophase-II
3) Interphase 4) Metaphase -II

130. Due to the occurrence of which phenomenon in Meiosis, evolution of organisms takes place
1) Synapsis 2) spiralization
3) Crossing over 4) Teminalization

131. Crossing over involves
1) Deletion of chromosomes
2) Duplication of chromosomes
3) Exchange of genetic material
4) Segregation of homologous chromosomes

132. Crossing over occurs during
1) Pachytene 2) Diplotene
3) Zygotene 4) Leptotene

133. Exchange of chromosome segment between maternal and paternal chromatids during meiosis is called
1) Linkage 2) Crossing over
3) Diakinesis 4) Synapsis

134. During prophase-I homologous chromosomes pair with each other to form bivalents. Each bivalent is an association of
1) Two chromatids and one centromere
2) Two chromatids and two centromeres
3) Four chromatids and four centromeres
4) four chromatids and two centromeres

135. The stage in meiosis I where the homologous chromosomes divide is
1) Anaphase-II 2) Diplotene
3) Diakinesis 4) Pachytene

136. Disappearance of attractive forces between homologous chromosomes occurs in
1) Zygotene 2) Pachytene
3) Diplotene 4) Diakinasis

137. Homologous chromosomes exchange segment with block of genes during
1) Pachytene 2) Zygotene

3) Diplotene 4) Lepotene

138. During anaphase-I, which one of the following separate from each other and reach opposite poles
1) Chromosomes 2) Chromatids
3) Chromonemata 4) Centromeres

139. Chromosome number in meiosis is halved during
1) Metaphase-I 2) Anaphase-I
3) Prophase-I 4) Telophase-I

140. The total no.of nuclear divisions in Meiosis
1) 1 2) 2
3) 4 4) 3

141. In a tetraploid cell Meiosis occurs. what is the chromosomal condition of daughter nuclei formed after Meiosis-I is
1) Diploid 2) Haploid
3) Tetraploid 4) Polyploid

142. Meiosis-I and Meiosis-II are not similar with one another because
1) In both, Prophase, Metaphase, Anaphase, Telophase will not occur
2) Chromosome number is not reduced
3) In both spiralization and despiralization will not occur
4) Spindles are formed

143. The cell division responsible for the formation of gametes in animal cells is
1) Mitosis 2) Meiosis
3) Amitosis 4) Both Mitosis and Meiosis

144 Meiosis involves
1) One division of nucleus and one division f chromosomes
2) Two division of nucleus and one division of chromosomes
3) One division of nucleus and two divisions of chromosomes
4) Two divisions of nucleus and two division of chromosomes

145 Crossing over of chromatids during meiosis leads to
1) Mutation 2) Sex determination
3) New gene combination
4) Extinction of species

146. Nuclear envelope reappears at
1) Metaphase 2) Prophase
3) Anaphase 4) Telophase

147. Meiosis does not occurs in?
1) Ovule 2) Anther
3) Microsporangia 4) Shoot tip

148. Which of the two events restore the normal number of chromosomes in life cycle
1) Mitosis and Meiosis
2) Meiosis and fertilization
3) Fertilisation and mitosis
4) Only meiosis

149. A cell is bound to divide, if it has entered
1) G_1- Phase 2) G_2- phase
3) Prophase 4) S – phase

150. Which of the following not occurs in Anaphase – I
1) Segregation of homologous chromosomes
2) Contraction in spindle
3) Poleward movement of chromosomes
4) Division of centromere

151 Homologous chromosomes shows maximum attraction during
1) Leptotene 2) Zygotene
3) Pachytene 4) Diplotene

152. In meiosis
1) Division of nucleus twice but replication of DNA only once
2) Division of nucleus twice and replication of DNA twice
3) Division of nucleus once and replication of DNA is also once
4) Division of nucleus once and DNA-replication is twice

153. Gap between meiosis – I and II is called
1) Interphase 2) Interkinesis
3) Diakinesis 4) Metakinesis

154. Many cells function properly and divide mitotically though they do not have
1) Plasma membrane 2) Cytoskeleton
3) Mitochondria 4) Plastids

155. At anaphase – II of meiosis each chromosome contains
1) 4 DNA 2) 3-DNA
3) 2-DNA 4) 1-DNA

156. Each chromosome composed of one chromatid in
1) Anaphase-I 2) Anaphase-II
3) Metaphase-I 4) Metaphase-I

157. Homologous chromosomes are
I.) Uniparental II) Biparental
III) Multiparental

1) I only 2) II only
3) I & II only 4) III only

158. Meiocytes are
I) Haploid cells II) Diploid cells
III) Polyploid cells (even)
1) I only 2) II only
3) I & II only 4) II and III

159. Identify the correct sequence of the following subphases of prophase 1
A) Zygoten e B) Diplotene
C) Diakinesis D) Leptotene
E) Pachytene
1) D-A-E-B-C 2) C-A-E-B-D
3) D-E-A-B-C 4) D-A-E-C-B

160. During Terminalization
1) Movement of chromosomes towards the poles occur
2) Movement of chromatids towards the poles occur
3) Movement of chaisma towards the poles occur
4) Movement of chromosomes towards the centre occure

161. Mention the sequence of changes occuring during the prophase-I of Meiosis
1) Leptotene stage ® crossing over ® spiralization® terminalization® synapsis
2) Spiralization ® Leptotene stage ® Crossig over® terminalisation ® synapsis
3) Leptotene stage® synapsis® crossing over ® terminalisation ® despiralization
4) Leptotene stage® synapsis® crossing over ® spiralization® terminalisation

162. Sequence of stages in Prophase-I
1) Leptotene, Pachytene, Zygotene, Diakinesis, Diplotene
2) Zygotent, Leptotene, Pachytene, Diplotene, Diakinesis
3) Diplotene, Diakinesis, Pachytene, Zygotene, Leptotene
4) Leptotene, Zygotene, Pachytene, Diplotene, diakinesis

163. Find out the correct sequence of events during meiosis
1) disjunction 2) Crossing over
3) Synapsis 4) terminalisation
1) 3-2-1-4 2) 3-2-4-1
3) 2-3-1-4 4) 3-4-1-2

164. What is the number of chromatids present in anaphase-I at one pole when a pollen mother cell of potato undergoes meiotic division
1) 24 2) 96
3) 48 4) 26

165. Find out the incorrect match
1) Leptotene –Nucleus is enlarged
2) Anaphase II–Disjunction of bivalents
3) Pachytene– Crossing over
4) Metaphase I–Orientation of bivalents

166. DNA duplication occurs in
1) Mitosis only 2) Meiosis only
3) Meiosis-I and Mitosis
4) Meiosis -II and Mitosis

167. Meiosis involves two divisions. These are
1) One nuclear division and one somatic division
2) One equational and one somatic division
3) One reductional division and one mitotic division
4) One reduction division and one amitotic division

168. In which one of the following chromosomes are divided
1) Mitosis only 2) Meiosis only
3) Meiosis-I and Mitosis
4) Meiosis -II and Mitosis

169. If the endosperm cell of a plant has 36 chromosomes what will be the number of chromosomes at each pole during Anaphase-I
1) 24 2) 12
3) 72 4) 48

170. If a cell is having 12 chromosomes on metaphase II equatorial plate, it belongs to
1) Oryza sativa 2) Nicotiana tabaccum
3) Triticum aestivum 4) Allium cepa

171. In a plant Meiotic division in 20 pollen mother cells and Meiotic divisions in20 Megaspore mother cells occur. How many seeds are formed
1) 25 2) 20
3) 40 4) 80

172. For the formation of 100 seeds, how many pollen grains are required
1) 100 2) 50
3) 25 4) 200

173. Number of chromosomes in a gamete of tobacco
1) 34 2) 24 3) 44 4) 54

174. If the diploid chromosomes is 40 , the number of chromosomes in gametes
1) 30 2) 40
3) 20 4) 4

175. The number of meiotic and mitotic divisions required for formation of 120 male gametes in angiosperms
1) 15, 120 2) 30, 60
3) 15, 60 4) 30, 120

176. Number of minimum reduction divisions required for the production of 100 pollen grains
1) 50 2) 25
3) 100 4) 75

177. When a cell of potato undergoes meiosis, each of the four resulting cells will have
1) 48 chromosomes 2) 24 chromosomes
3) 12 chromosomes 4) 96 chromosomes

178. When a cell with 8 chromosomes is undergoing meiosis, how many chromosomes are found on each metaphase plate in meiosis-II
1) 16 2) 8
3) 4 4) 32

179. In the formation of 50 zygotes in a tomato flower the minimum number of meiotic divisions involved will be
1) 59 2) 63
3) 109 4) 99

180. How many meiotic divisions shall produce 4 fertile eggs in Dolichos
1) 1 2) 2
3) 4 4) 8

181. Number of meiotic divisions required to form 120 seeds is
1) 30 2) 120
3) 150 4) 240

182. The number of meiotic and mitotic generations required for the formation of 60 antipodals in a multiovulate ovary
1) 60, 180 2) 20, 60
3) 60, 120 4) 40, 120

183. Number of spindle apparatii formed during meiosis for the formation of 80 microspores
1) 10 2) 80
3) 20 4) 60

184. Number of spindle apparatii formad during formation of one hundred microspores from microspore mother cells is
1) 25 2) 75
3) 50 4) 100

185. A cell of Haplopappus gracilis is in anaphase stage of mitosis. A cell of Oryza sativa is in Metaphase stage of Meiosis-I. What is the ratio of chromosomes of these two cells
1) 1 : 6 2) 1 : 4
3) 1 : 3 4) 1 : 2

186. Colchicine, a mitotic ison, arrests the cell division in:
1) G_1 - phase 2) G_2 - phase
3) Anaphase 4) Metaphase

187. Number of meiosis required to produce 100 ovules in angiosperms is
1) 125 2) 100
3) 25 4) 75

188. If the number of bivalents are 8 in metaphase – I, what shall be the number of chromosomes in daughter cells after meiosis – I and meiosis – II respectively
1) 8 and 4 2) 4 and 4
3) 8 and 8 4) 16 and 8

189. If the n = 16 in plant cell then how many bivalents possible in metaphase – I of meiosis
1) 32 Bivalents 2) 16 Tetravelents
3) 16 Bivalents 4) 32 Bivalents

TYPE - III

190. Match the following

List –I	List –II
A) Doubling of DNA	I) Anaphase
B) Double the number of chromosomes	II) Cytokinesis
C) Double the number of cells	III) S-phase
D) Doubling of cell organelles	IV) G_2–phase

	A	B	C	D
1)	III	I	II	IV
2)	I	III	IV	II
3)	IV	II	I	III
4)	II	IV	III	I

CH-11 : CELL CYCLE AND CELL DIVISION

191. Find out the correct match

List -I	List –II
A) Metaphase	I) Shape of the chromosome
B) Anaphase	II) Exchange of chromatids
C) Diakinesis	III) Counting of chromosomes
D) Crossing over	IV) Terminalisation
	V) Structure of the chromosomes

	A	B	C	D
1)	IV	I	II	III
2)	V	I	IV	II
3)	II	IV	V	I
4)	V	I	III	IV

192. Study the following Lists

List- I	List-II
A) Crossing over	I) Diplotene
B) Synapsis	II) Zygotene
C) Weakening of synaptonemal force	III) Leptotene
D) Terminalisation	IV) Pachytene
	V) Diakinesis

	A	B	C	D
1)	IV	II	I	V
2)	V	III	II	I
3)	IV	II	V	III
4)	III	II	IV	V

193. Matching the following

List - I	List -II
A) Attraction between homologous	I) Crossing over
B) exchange of genetic material between homologous chromosomes	II) Synapsis
C) Repulsion between homologous	III) Segregation
D) Separation of homologous	IV) Diplotene

	A	B	C	D
1)	II	I	IV	III
2)	I	III	IV	II
3)	IV	II	I	III
4)	II	IV	III	I

194. Match the following

List - I	List-II
A) Separation of genomes	I) Anaphase I
B) Separation of chromatids	II) Anaphase of mitosis
C) Formation of spindle apparatus	III) Metaphase
D) Genetic recombinations	IV) Prophase I

	A	B	C	D
1)	I	II	III	IV
2)	I	III	IV	II
3)	IV	II	I	III
4)	II	IV	III	I

195. Match the following

List - I	List-II
A) Anaphase–I	I) One spindle apparatus
B) Anaphase–II	II) Separation of two genomes
C) Metaphase-II	III) Two spindle apparatti
D) Telophase-II	IV) Separation of two chromatids
	V) Four daughter nuclei

	A	B	C	D
1)	II	IV	I	III
2)	III	I	IV	V
3)	II	IV	III	V
4)	III	II	V	I

EXERCISE - IV

196.

STAGE	EVENT	RESULT
I. S-phase	Autocatalysis of DNA	Doubling of DNA
II. G2-Phase	Heterocatalysis of DNA	Increased protein content.
III. Prophase	Disappearance of nuclear membrane	Shortening of chromosomes
IV. Metaphase	Formation of spendle fibers	Movement of chromosomes

Choose correct pair

1) I & II 2) II & III 3) III & IV 4) II & IV

197.

STAGE	EVENT	RESULT
I. Prophase	Condentation of chromosome	Disapparance of nuclear membrane
II. Metaphase	Formation of spendle fibers	Orientationof chromosomes
III. Anaphase	Contraction of spindle fiber	movement of chromosome towards center
IV. Telophase	Reappearance of nuclear membrane	Disapparance of nucleus

Choose correct pair

1) I & II 2) II & III 3) III & IV 4) II & IV

198.

STAGE	EVENT	RESULT
I. Leptotene	Synaptonemal complex	Bivalent
II. Zygotene	Synopsis	Bivalent
III. Pachytene	Crossing over	Genetic variation
IV. Diplotene	Terminalization	Disappearance of Synaptionemal complex

Choose correct pair

1) I & II 2) II & III 3) III & IV 4) II & IV

199.

STAGE	EVENT	RESULT
I. Metaphase I	Bivalents on metaphase plate	Centromers are in one line.
II. Metaphase II	Invisble chromosomes on metaphasic plate	Centromers are in one line.
III. Anaphase I	Reduction of chromosomal number to half	Movement of homologous chromosomes towards poles
IV. Anaphase II towards poles	Doubling of chromosomes	Movement of daughter chromosome

Choose correct pair

1) I & II 2) II & III 3) III & IV 4) II & IV

200.

STAGE	EVENTS	RESULT
I. Prophase I	Crossing over	Genetic recombination
II. Metaphase I	Formation of bivalents	Bivalents on equatorial plate
III. Anaphase I	Separation of genome	Reduction of chromosomal number
IV. Telophase I	Formation of haploid Nuclei	Fusion of chromatids

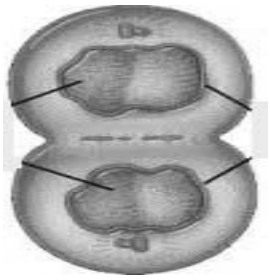
Choose correct pair

1) I & II 2) II & III 3) III & IV 4) II & IV

CH-11 : CELL CYCLE AND CELL DIVISION

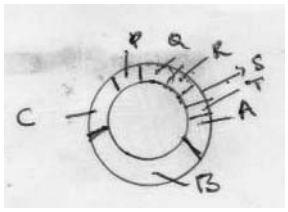
DIAGRAMS BASED QUESTIONS

201 A stage in cell division is shown. Select the answer which gives correct identification of the stage with its characters.



1) Late anaphase - Chromsomes move away from quitorial plate golgie complex not present.
2) Cytokinesis - Cell plate formation mitochondria distribution between daughter cells.
3) Telophase - Endoplasmic reticulum and nucleolus not reformed yet.
4) Telophase - Nuclear envelop reforms golgi complex reformed.

202. In cell cycle if A is G_1 stage identify anaphase

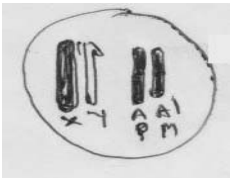


1) B 2) Q
3) R
4) T

203. In the diagram, if Q is metaphase DNA is syntehsized between
1) A and B 2) A and C
3) P and Q 4) R and T

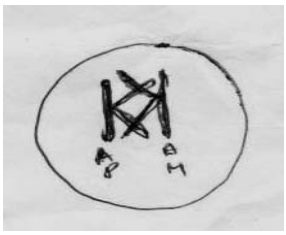
204. The cell will enter G_0 stage after
1) Q 2) R
3) A 4) B

205. This diagram indicates that



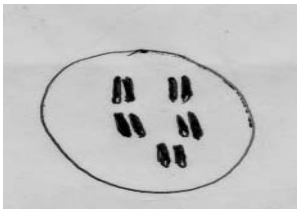
1) The chromosomes that pair during zygotene are sex chromosomes only.
2) Synopsis involves either autosomes or allosomes.
3) Synopsis involves both autosomes and allosomes.
4) Synopsis occurs in both mitosis and meiosis.

206. What is wrong with this diagram related to pachytene?



1) Chromosomes are not condensed.
2) Chiasmata are two in number in the bivalent.
3) Nucleolus is not represented.
4) Crossing over occurs in four stranded stage.

207. The is the stage of meiosis called zygotene. It belongs to



1) Happlopappus gracillis
2) Solanum tuberosum
3)Allium 4) None of the above

TYPE - V

208. Activity of recombinase (ligase + Endonuclease) (EAMCET 2010)
1) Leptotene 2) Zygotene
3) Pachytene 4) Diplotene

209. Identify wrong pair of statements from the following (EAMCET 2011)
I) Cell organells are nearly formed in G_2 phase.
II) Doubling of chromosomes occur in S phase of interphase.
III) Nucleiformed after meiosis-I are haploid.
IV) Terminalization occurs in Anaphase-I
1) II and IV 2) III and IV
3) I and II 4) I and IV

210. Match the following. (NEET 2013)

List - I	List - II
A) G_2 phase	I) Fusion of micro tubules to form spindle aparatus
B) Prometaphase	II) Production of energy required for spindle formation.
C) Anaphase	III) Recombination of genetic material
D) Pachytene	IV) Contraction of spindle
	V) Reappearance of plasmasome.

1) A-II, B-I, C-IV, D-III
2) A-I, B-II, C-III, D-IV
3) A-III, B-IV, C-I, D-II
4) A-I, B-IV, C-II, D-V

211. Zygotic meiosis is unique to **(AFMC-1994)**
1) Spyrogyra 2) Chlamydomonos
3) Pteris 4) both 1 and 2

212. DNA replication occurs during **(C:PMT-94)**
1) Interphase 2) Prophase
3) Metaphase 4) Anaphase

213. Complete process of meiosis involves **(CPMT-1995)**
1) one cytoplasmic division wth only one chromosome duplication
2) two cytoplasmic divisions with one duplication of chromosome.
3) two cytoplasmic divisions with duplication of chromosome
4) one cytoplasmic division with two duplication of chromosome.

214. Phase of the cell cycle unique for DNA replication is **(CPMT-95)**
1) G_1 2) G_2 3) S 4) M

215. How many microspore mother cells are needed to form 100 microspores **(CBSE-95)**
1) 25 2) 50 3) 75 4) 100

216. Chromatids of pachytene chromosomes are attached at **(CBSE-96)**
1) chromomere 2) centriole
3) chromocenter 4) centromere

217. Cytokinesis is the phenomena of division of **(AIIMS -96)**
1) Nucleus 2) Chromosomes
3) Cytoplasm 4) All the above

218. Exchange of paternal and maternal chromatid material during cell division is **(CBSE-96)**
1) crossing over 2) synopsis
3) dyed formation 4) bivalent formation

219. Centromere is a part of **(CBSE -97)**
1) centrosome 2) chromosome
3) E.R. 4) ribosome

220. During meiosis **(JIPMER-97)**
1) Cytokinesis takes place
2) Cytokinesis do not occur
3) Cytokinesis may and may not occur
4) None of the above

221. Chromosomes appear as thin long threads during **(AFMC -97)**
1) Zygotene 2) Leptotene
3) Pachytene 4) Prophase.

222. Nuclear membrane reappears in **(CBSE-97)**
1) Anaphase 2) Metaphase
3) Telophase 4) Prophase

223. The stage of mitosis in which nucleolus and nuclear membrane disappear and chromosomes become distinct is **(AFMC-98)**
1) Zygotene 2) Pachytene
3) Diplotene 4) Diakinesis

224. The replication of DNA is a pre-requisite for a eukaryotic cell to undergo division. During the cell cycle the DNA replicates in **(2009)**
1) S-phase 2) G_1-Phase
3) G_2-phase 4) M-phase

225. In meiosis, the daughter cells are not similar to that of parent because of **(2005)**
1) Crossing over 2) Synapsis

3) Both a and b 4) None of the above

226. Which of the following stage during meiosis is concerned with DNA replication ? **(2003)**
1) Interphase 2) Prophase
3) Metaphase 4) Anaphase

227. Crossing over helps in : **(2002)**
1) Pure line selection 2) Inducing mutation
3) Inducing polyploidy
4) Recombination between the genes

228. Zygotic meiosis is found in : **(2001)**
1) Fern 2) Fucus
3) Funaria 4) Chlamydomonas

AIIMS

229. Which one of the following is the best stage to observe the shape, size and number of chromosomes in a cell ? **(2010)**
1) Interphase 2) Prophase
3) Metaphase 4) Telophase

230.(A) : Reduction division occurs in anaphase so there is no need of meiosis.
(R) : Meiosis-II occurs to separate homologous chromosomes. **(2009)**

231 (A) : Interphase of cell division is also known as formative phase.
(R) : In formative phase new cells are produced from pre-existing cells, through meiosis division. **(2007)**

232. The quiescent centre in root meristem serves as a **(2003)**
1) Site for storage of food which is utilized during maturation.
2) Reservoir of growth hormones
3) Reserve for replenishment of damaged cells of the meristem
4) Region for absorption of water

233. Spindle fibers of mitotic cell are madeup of **(2001)**
1) Tubulin 2) Actin
3) Myosin 4) Collegen

AIPMT

234. During mitosis ER and nucleolus begin to disappear in **(2010)**
1) Late prophase 2) Early metaphase
3) Late metaphase 4) Early prophase

235. Which stages of cell division do the following processes (A) and (B) takesplace respectively
A - Spindle formation B - Nucleolus formation **(2010)**
1) Metaphase - Telophase
2) Telophase - Metaphase
3) Late Anaphase - Prophase
4) Prophase - Anaphase

236. Given below is a schematic break-up of the phases/stages of cell cycle. Which one of the following is the correct indication of the stage/ phase in the cell cycle **(2009)**
1) C-Karyokinesis 2) D-synthetic phase
3) A-cytokinesis 4) B-metaphase

237. Synapsis occur's between **(2009)**
1) mRNA and ribosomes
2) Spindle fibres and centromere
3) Two homologous chromosome
4) A male and a female gemete

238. **(A) :** The quiescent centre act as a reservoir of relatively resistant cells which constitute a permanent source of active initials.
(R) : The cells of the inactive region of quiescent centre become active when the previous active initials get damaged. **(2007)**
a) Both A and R are true and R is the correct explanation to A.
b) Both A and R are true but R is not the correct explanation to A.
c) A is true but R is false
d) A is false and R is false

239. At what stage of the cell cycle are histone proteins synthesized in a eukaryotic cell ? **(2005)**
1) During entire prophase
2) During telophase 3) During S-phase
4) During G_2 stage of prophase

240. In the somatic cell cycle : **(2004)**
1) In G_1 phase DNA content is double the amount of DNA present in the original cell
2) DNA replication takes place in S-phase
3) A short interphase in followed by a long mitotic phase
4) G_2 phase follows mitotic phase

241. If you are provided with root-tips of onion in your class and are asked to count the chromosomes, which of the following stages can you most

conveniently look into ? **(2004)**
1) Metaphase 2) Telophase
3) Anaphase 4) Prophase

242. The cells of the quiescent centre are characterized by **(2003)**
1) Having light cytoplasm and small nuclei
2) Dividing regularly to add to the corpus
3) Dividing regularly to add to the tunica
4) Having dense cytoplasm and prominent nuclei

243. Mitotic spindle is mainly composed of proteins **(2002)**
1) Tubulin 2) Myosin
3) Actomyosin 4) Myoglobin

244. In grasses what happens in microspore mother cell for the formation of mature pollengrains ? **(2001)**
1) One meoitic and two mitotic divisions
2) One meotic and one mitotic division
3) One meitoic division
4) One meitoic division

245. The replication of DNA is a pre-requisite for a eukaryotic cell to undergo division. During the cell cycle, the DNA replicates in : **(2000)**
1) S-phase 2) G_1 - phase
3) G_2 - phase 4) M - phase

JIPMER

246. How many times mitotic divisions are needed for a single cell to make 128 cells **(2009)**
1) 7 2) 14 3) 28 4) 32

247. At what stage of the cell cycle are histone protein synthesized in a eukaryotic cell ? **(2007)**
1) During entire prophase 2) During telophase
3) During S-phase
4) During G_2 stage of prophase

248. Quiescent centre is the zone of **(2006)**
1) Least mitotic activity in the root apex
2) Least mitotic activity in the shoot apex
3) Maximum mitotic activity in the root apex
4) Maximum mitotic activity in the shoot apxe

249. Abnormal growth of the tumor in cancer is due to **(2005)**
1) Abnormal mitotic division
2) Accumulation of body fluid
3) Abnormal meiotic division
4) Metastasis

250. In meiosis division is **(2005)**
1) Ist reductional and 2nd equational
2) Ist equational and 2nd reductional
3) Both reductional 4) Both equational

251. Which typical stage is known for DNA replication ? **(2003)**
1) Metaphase 2) G_1-phase
3) S-phase 4) G_2-phase

252. When paternal and material chromosomes change their material with each other in cell division this event is called **(2003)**
1) Synapsis 2) Crossing over
3) Bivalent-forming 4) Dyad-forming

253. Mitotic spindle is mainly composed of which proteins ? **(2002)**
1) Actin 2) Myosin
3) Actomyosin 4) Myoglobin

254. Clevage is a unique form of mitotic cell division in that **(2001)**
1) The plasma membranes of daughter cells do not separate
2) No spindle develops to guide the cells
3) There is no growth of cells
4) The nucleus does not participate

CH-11 : CELL CYCLE AND CELL DIVISION

KEY

MODEL TEST- I

1) 3 2) 2 3) 4 4) 2 5) 1 6) 2
7)3 8) 1 9) 2 10) 3 11) 1 12) 2
13) 3 14) 3 15) 3 16) 3 17) 3 18) 3
19) 2 20) 2

MODEL TEST- II

21) 4 22) 2 23) 1 24) 2 25) 1 26) 2
27) 4 28) 4 29) 2 30) 1 31) 2 32) 2
33) 1 34) 2 35) 3 36) 2 37) 4 38) 2
39) 1 40) 2 41) 2 42) 2

MODEL TEST- III

43) 3 44) 4 45) 4 46) 2 47) 1 48) 1
49) 3 50) 2 51) 4 52) 2 53) 3 54) 1
55) 2 56) 1 57) 2 58) 2 59) 3 60) 2
61) 3 62) 4 63) 3 64) 3

MODEL TEST- IV

65) 2 66)4 67) 1 68) 4 69) 2 70) 2
71) 3 72) 3 73) 3 74) 2 75) 2

TEST - 1

76) 3 77) 4 78) 2 79) 1 80) 4 81) 2
82) 1 83) 3 84) 4 85) 2 86) 1 87) 2
88) 3 89) 3 90) 2 91) 2 92) 3 93) 2
94) 1 95) 3 96) 2 97) 2 98)3 99)1
100)4 101) 1 102) 2 103) 4 104) 3 105) 3
106) 1 107) 1 108) 2 109)2 110)4 111)4
112) 4

TEST - 2

113) 2 114) 3 115) 1 116) 3 117) 2 118) 1
119) 1 120) 2 121) 2 122) 4 123) 2 124) 3
125) 2 126) 2 127) 2 128) 1 129) 4 130) 3
131) 3 132) 1 133) 2 134) 4 135) 1 136) 3
137) 1 138) 1 139) 2 140) 4 141) 2 142) 2
143) 2 144) 2 145) 3 146) 4 147) 4 148) 2
149) 1 150) 4 151) 2 152) 1 153) 2 154) 4
155) 4 156) 2 157) 2 158) 4 159) 1 160) 3
161) 3 162) 4 163) 2 164) 1 165) 2 166) 3
167) 3 168) 4 169) 2 170) 2 171) 2 172) 1
173) 2 174) 3 175) 1 176) 2 177) 2 178) 2
179) 2 180) 3 181) 3 182) 2 183) 3 184) 2
185) 3 186) 4 187) 2 188) 3 189) 3

TEST - 3

190) 1 191) 2 192) 3 193) 1 194) 1 195) 3

TEST - 4

196) 1 197) 2 198) 2 199) 3 200) 1

DIAGRAM BASED QUESTIONS

201) 4 202) 3 203) 2 204) 3 205) 2 206) 3 207) 4

TEST - 5

208) 3 209) 1 210) 1 211) 4 212) 1 213) 2
214) 3 215) 1 216) 4 217) 3 218) 1 219) 2
220) 1 221) 2 222) 3 223) 1 224) 1 225) 1
226) 1 227) 4 228) 4 229) 3 230) 4 231) 4
232) 3 233) 1 234) 1 235) 1 236) 2 237) 3
238) 1 239) 3 240) 2 241) 1 242) 4 243) 1
244) 3 245) 1 246) 1 247) 3 248) 1 249) 1
250) 1 251) 3 252) 2 253) 1 254) 3

CH: 12 : HISTOLOGY AND ANATOMY OF FLOWERING PLANTS

INTRODUCTION

- KATHERINE ESAU reported in her publications that the curly top virus spreads through a plant via the food conducting phloem tissue.
- Dr Esau's plant anatomy took a dynamic, developmental approach designed to enhance one's understanding of plant structural and had enormus impact world wide.
- She also published 'The anatomy of seed plants' which is refferd to as webster's of plant biology.
- Peter Raven(director of Anatomy and morphology, Missouri Botanical Garden) remembered that Easu 'absoultely dominated' the field of plant biology.
- **Histology** is the study of different tissues in the plant body.
- **Anatomy** is the branch which deals with the study of **gross internal structure** of plant organs as observed after section cutting. Study of this branch started in 1671.

TISSUE

- Tissue is a group of similar or dissimilar cells having a common origin and usually performing a similar function.

TYPES OF TISSUES

- Tissues may be classified into two groups based on wheather the cells being formed are capable of dividing or not. viz,.
  - **A. Meristematic tissues**
  - **B. Permanent tissues**

12.1.1 A. MERISTEMATIC TISSUES (MERISTEMS)

- Growth in plants is largely restricted to specialised regions of active cell division called meristems.
- The term **meristem** has been derived from a Greek word **meristos** - which means **divided** or having cell division activity, so meristem is a **group of cells which has power of continuous division**.
- Plants have different kinds of meristems
- **Apical meristem :** It is found at the **apex** of growing points of root and shoot. It **divides continuously** and brings about growth in length of shoot and root. The apical meristem includes **promeristem** as well as **primary meristem**.

  Eg.:Root apical merstem occupies the tip of a root while the shoot apical meristem occupies the distant most region of the stem axis.
- During the formation of leaves and elongation of stem, some cells ' **left behind' from shoot apical meristem**, constitute the **axillary bud**. Such buds are present in the axils of leaves and are capable of forming a **branch** or **a flower**.
- **Intercalary meristem :** The meristem which occurs between mature tissues is known as intercalary meristem.It is present at the **base of internodes** and sheathing leaf bases of grasses and regenarate parts removed by the grazing herbivores.
- Both apical meristems and intercalary meristems are **primary meristems** because they appear early in the life of a plant and contribute to the formtion of the primary plant body.
- **Lateral meristem :** The meristems that occur in the mature regions of roots and shoots of many plants, particularly those that produce woody axis and appear later than primary meristem is called lateral meristem or secondary meristems. They are cylindrical meristems.They are located **parallel to the long axis** of the plant organs.Their activity results in **increasing the diameter** of the plant organs.These are responsible for producing the secondary tissues.

  Eg.; **Fascicular vascular cambium, interfascicular cambium and Cork cambium**.
- All secondary meristems are lateral meristems but all lateral meristmes are not secondary.

Eg.; Procambium is primary lateral meristem and inter fascicular cambium and cork cambium are secondary lateral meristems.

Permanent tissues

- **Permanent Tissues**:Following divisions of cells in both primary and secondary meristems, the newly formed cells become structurally and functionally specialised and lose the abilty to divide. such cells are termed permanent or mature cells and constitute the permanent tissues in which the cells have become structurally and functionally specialized and lose ability to divide.
- It is formed due to **division** and **differentiation** from meristematic tissue. The cells of this tissue may be **living** or **dead, thin-walled** or **thick-walled**. The thin walled tissues are generally **living** where as the thick-walled tissues may be **living** or **dead**.
- During the formation of the primary plant body, specific regions of the apical meristem produce dermal tissues, ground tissues and vascular tissues.

SIMPLE TISSUES

- Permanent tissues having all cells similar in structure and function are called **simple tissues.These are of three types :**
  (i) Parenchyma (ii)Collenchyma
  (iii) Sclerenchyma

(i) Parenchyma

(Para = Parallel, Chyma = Chains)

- Parenchyma forms major component within organs.Parenchyma is considered as the **precursor** of all other living tissues. It is also the most **primitive tissue** from phylogenetic point of view.
- The cells of the parenchyma are generally isodiametric.They may be spherical,oval, round,polygonal or elongated in shape. Their walls **thin** and made up of **cellulose.** They may either be closely packed or have small intercellular spaces.
- Parenchyma performs various functions like photosynthesis, storage and secretion.

(ii) Collenchyma

(Colla = glow, chyma = chains)

- Collenchyma is found as layers below epidermis in many **herbaceous dicot stems,petioles** an **younger regions of woody stems**. Collenchyma is **absent in roots** and **monocot stems and leaves**.
- It is found either as a homogenous layer or in patches. It consists of cells which are much thickened the corners due to a deposition of cellulose, hemicellulose and pectin.
- Collenchyma cells may be oval, spherical or polygonal and often contain chloroplasts.
- These cells assimilate food when they contain chloroplasts. Intercellular spaces are absent.
- They provide mechanical support to the growing parts of the plant such as young stem and petiole of a leaf.

(iii) Sclerenchyma (Greek : Scleros = hard)

- They are **dead cells and without protoplasts** and act as **purely mechanical tissue**.The cells are **long, narrow** and **pointed** at both ends.The cell walls are thick, **lignified** and have few or numerous **simple pits**.
- On the basis of variation in form, structure,origin and development sclerenchyma may be either Fibres or Sclereids.
- Fibres or sclerenchymatous fibre cells are long, narrow and thick walls, pointed at both ends and lignified and generally occur in groups in various parts of the plant.
- **Sclereids:** The sclereids are spherical, oval or cylindrical, highly thickened dead cells with very narrow cavities (lumen). These are commonly found in the fruit walls of nuts, pulp of fruits like guava, pear and sapota, seed coats of legumes and leaves of tea.
- Sclerenchyma provides mechanical support to organs.

COMPLEX TISSUES

- They are those permanent tissues which are **made up of more than one type of cells and these work together as a unit. .**
- The complex tissues are made up of **living** and **non-living cells** which perform different functions. The complex tissues act as single units. The complex tissues are also known as **vascular tissues**.
- They are of two types: **Xylem** and **Phloem**.

XYLEM (or) HYDROME

- The function of xylem is to **conduct water** and **mineral salts** upwards from the **root to the leaf** through stem and to give **mechanical strength** to

the plant body.

- First formed xylem **Protoxylem** later formed xylem **Metaxylem**
- In stems, the protoxylem lies towards the centre (pith) and the metaxylem lies towards the periphery of the organ. This type of primary xylem is called **Endrach.**
- In roots, the protoxylem lies towards the periphery and the metaxylem lies towards the centre. Such an arrangement of primary xylem is called **Exarch**.
- It is a **conducting tissue** and is composed of four different kinds of elements:
  1) Tracheids 2)Vessels
  3) Xylem fibres 4)Xylem Parenchyma

1) Tracheids

- A single tracheid is highly **elongated** or **tube like cell** with **hard, thick** and **lignified walls** and with tapering ends.These are **dead** with out protoplasm.
- In flowering plants, **tracheids and vessels are the main transporting elements.**
- Secondary wall layers possess thickenings which vary in form.
- Tracheids are **most primitive** water conduc tive components.Tracheids are **present in all vascular plants** (or tracheophytes)
- Tracheids occur alone in the wood of **gymnosperms**, whereas in the wood of **angiosperms** they occur with the vessels.

2) <u>Vessels</u>

- A vessel is a **long, cylindrical, tube-like Structure** made up of many cells called **vessel** members. Each has **lignified walls** and a **wide central cavity**. The cells are **dead** and **without protoplast**.
- Presence of vessels is a **characteristic feature of angiosperms.**
- Vessel members are interconnected through perforations in their common walls.
- **Gymnosperms lack vessels in their xylem**.
- Vessels also have various types of thickenings similar to tracheids.Vessels are present in almost all angiosperms but also found in some **Pteridophytes** and **Gymnosperms.** Few angiosperms lack **Vessels.**

3) Xylem fibres

- Sclerenchymatous cells associated with xylem are called **xylem fibres**. They are **long, narrow, thick** and **lignified cells**;usually pointed at both ends and have obliterated central lumens. These may be either septate or aseptate.They are **dead cells**.

4) Xylem parenchyma:

- The parenchymatous cells found in xylem are **living, isodiametric** and **thin walled. Their cell wall is made up of cellulose**. Xylem parenchyma cells are more common in primary xylem than secondary xylem.
- They store **food material in the form of starch or fat** and other substances like **tannins**. Radial conduction of water occurs by the ray parenchymatous cells.

<u>Phloem or Bast or Leptome</u>

- Phloem is another type of **conducting tissue** like xylem which is responsible for **conduction of food material from leaves to other parts of plants**.
- The phloem formed from the **procambium** is called **primary phloem** that consists of narrow sieve tubes and is referred to as **protophloem** and that formed from **vascular cambium** is called **secondary phloem** and has bigger tubes and is referred to as metaphloem.
- **The phloem is composed of four elements:**
  (i) Sieve tube elements
  (ii) Companion cells
  (iii) Phloem parenchyma
  (iv) Phloem fibres

(i) <u>Sieve tube elements:</u>

- Sieve tubes are **tube-like structures**, composed of **elongated cells**, arranged in **longitudinal series** and associated with **companion cells**.
- Their walls are **thin** and made of **cellulose**. In

a mature sieve tube the nucleus is **absent** but **peripheral cytoplasm** as well as **large vacuole is present.**

- The uniqueness of the sieve tube is that although **without nucleus**, it is living and the **nucleus of the companion cell controls its functional activities**.
- The end walls are perforated in a s**ieve like manner to form** the **sieve plates**.
- **Gymnosperms** have **albuminous cells** and **sieve cells**. They lack sieve tubes and companion cells..

Sieve cells

- Sieve cells are living cells, having both cytoplasm and nucleus when they are young but lack nucleus at merturity.

(ii) Companion cells:

- These are **specialised parenchyma cells** which are closely associated with the sieve tube elements in their **origin, position** and **function**.
- The sieve tube element and companion cells are connected by a **pit field** present between their common longitudinal walls.
- Companion cells help in maintaing **pressure gradient** in the sieve tubes.
- The companion cell has **dense cytoplasm** and **prominent nucleus**.Its **nucleus** also controls the metabolic activities of the sieve tube.
- Companion cells are characteristic feature of angiosperms; they are absent in **gymnosperms** & **pteridophytes**.

(iii) Phloem parenchyma:

- These are **living parenchymatous cells** which are **elongated, tapering cylindrical cells.**
- The cells have **dense cytoplasm** and **nucleus**. The cell-wall is composed of **cellulose** and has **pits** through which most of the **plasmodesmatal connections** exist between the cells.
- Phloem parenchyma store **food material** and other substances like **resins, latex** and **mucilage.**
- Phloem parenchyma is absent in most of the monocots.

(iv) Phloem fibres (Bast fibres) :

- These are much **elongated, unbranched** (rarely branched) and have **pointed, needle-like apices**.
- They are **sclerenchymatous cells**. Their cell wall is quite thick with **simple** or slightly bordered pits. At maturity these fibres lose their protoplast and become **dead**.
- These are generally absent in primary phloem but are found in the secondary phloem
- Phloem fibres of jute, flax and hemp are used commercially.

Plants	Tracheids	Vessels	Sieve tubes	Companion cells	Sieve cells	Albuminous cells
Pteridophyts	✓	X	X	X	✓	X
Gymnosperms	✓	X	X	X	✓	✓
Angiosperms	✓	✓	✓	✓	X	X

(Note : Exceptions are there in plants)

The Tissue system

- Tissues vary depending on their location in the plant body. Their structure and fuction would also dependent on location.

Types of Tissue Systems:

- On the basis of structure and function there are three types of tissue systems.
  A. The epidermal tissue system.
  B. The ground or fundamental tissue system.
  C. The vascular/conducting tissue system.

A.The Epidermal tissue system :

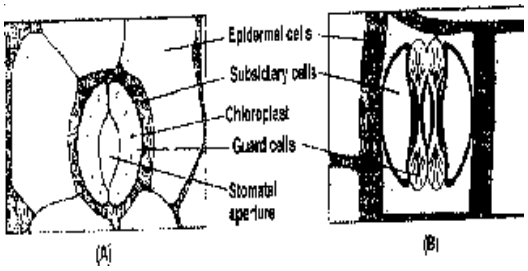
Epidermis:

- Epidermis (**epi** : upon; **derma** : skin) is the **outer most layer** of the primary plant body, which has direct contact with external environment.
- It comprises of epidermal cells, stomata and the epidermal appendages - the trichomes and hairs.

- Epidermis is made up of elongated, compactly arranged cells, which form a continuous layer.
- Epidermis is usually single layered.Epidermis may also be **multilayered** as in the **aerial roots of** Orchids and **leaves of** *Nerium* and *Ficus*.
- Epidermal cells are parenchymatous with a small amount of cytoplasm lining the cell wall and large vacuole.
- The outer wall of epidermis is **thick** and usually covered by a **cuticle** formed by the deposition of a **waxy material** secreted in the epidermal cells.Cuticle **prevents the loss of water.**
- The cuticle is **thickest** in the **xerophytic plants**. Cuticle is **absent** in **root.**
- Some epidermal cells of certain **monocots** (grasses, maize, sugarcane) are comparatively **large, vacuolated** and **thin-walled.**These are called **bulliform** or **motorcells**. These cells **store water** and help in **closing and opening or rolling of leaves.**

Stomata:

- Stomata are **very small openings** found in the **epidermis** of green aerial parts of the plant especially the leaves. They regulate the process of **transpiration** and **gaseous exchange**.
- Pore of each stoma is surrounded by **two kidney shaped** (= semilunar) cells, called **guard cells**. The guard cells are **living** and contain **chloroplasts**. The inner walls (towards stomatal pore) are **thicker** than the outer walls.The guard cells regulate the opening and closing of the stomata.
- Guard cells are **kidney** shaped in **dicots** and are **dumb bell** shaped in **monocots**.
- Sometimes, a few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells or accessory cells.
- The stomatal aperture, guard cells and the surrounding subsidiary are together called **stomatal apparatus.**



structure of Stomata

The epidermal appendages:

- In many plants epidermis bears outgrowths which are multicellular and are called **trichomes** or **hairs** which vary markedly in their shape, structure and function. They may be branched or unbranched and soft or stiff.
- These multi cellular trichomes of stem help in **checking excess loss of water** (reduction of water loss).Trichomes may be sometimes **secretory.**
- **Root hairs:**The epidermis of roots bears root hairs in the specialized region - **the root hair zone**. The root hairs are unicellular and are formed due to the elongation of the epidermal cells
- These are not protuberances or appendages.It plays an important role in **anchoring** the plant body in the soil besides absorbing **water** and **mineral solution** from it. They are enlargements of special epiblema cells called **trichoblasts.**

Ground or Fundamental tissue systems:

- It constitutes the interior of organs except vascular tissue system. Ground tissue system of the leaves is called **mesophyll**.
- The ground tissue system forms the **main bulk of the plant body**. It includes all the tissues **except epidermis** and **vascular bundles**.
- The primary function of this tissue system is **storage** and **manufacture of food material**.
- This system has different kinds of tissues such as **parenchyma,collenchyma** and **sclerenchyma**; of these, parenchyma is most abundant and carries out a variety of functions.
- In the leaves, the ground tissue consists of thin walled chloroplast containing cells and is called **Mesophyll.**
- Parenchymatous cells are usually present in cortex, pericycle, pith and medullary rays, in the primary stems and roots.

- In **monocotyledonous stem** (with scattered vascular bundles) the ground tissue is **not differentiated** into cortex, pericycle and pith.

Vascular tissue system:

- Central column of axis (root and stem) is called **stele**. All tissues on the inner side of the endodermis such as pericycle, vascular bundle and pith constitute the **stele**.
- The vascular bundle is having **xylem, phloem** and **cambium** (if present).
- Xylem may be **exarch** or **endarch**. In **roots**,xylem is **exarch** or **centripetal**, i.e.; protoxy lem or first formed xylem is towards periphery. In **stem**, xylem is **endarch** or **centrifugal**, i.e.; protoxylem is towards centre (pith).
- When xylem and phloem are conjoint (jointed), they are regarded as conjoint vascular bundle.
- If the **cambium is present** in between the xylem and phloem are said to be **open vascular bundle** (e.g.; dicots). They have the ability to form **secondary xylem** and **secondary phloem.**
- If the **cambium is absent** in between the xylem and phloem are said to be **closed vascular bundle** (e.g; monocots).They donot form secondary tissues.

Types of vascular bundle:

- According to the arrangement of xylem and phloem vascular bundles are of three types:
  1) Radial 2) Conjoint 3) Concentric
- **1)Radial :** When xylem and phloem are arranged in an alternate manner on **different radii**, such vascular bundles are called **radial**.
  Eg.Roots of all plants contain radial vascular bundle.
- **2) Conjoint :** When xylem and phloem are present on the **same radius**, this type of vascular bundles are known as conjoint.Conjoint vascular bundles are the characteristic feature of **stems and leaves**. Depending upon the mutual relationship of xylem and phloem, these are divided into two types:
- **(i) Collateral**:When xylem and phloem lie together on the **same radius**, xylem being **internal** and phloem **external**, such vascular bundles are called collateral which are may be **closed** or **open**.Eg. vascular bundles in the stems of gymnosperms and angiosperms.
- **(ii) Bicollateral:**These are **two patches of phloem** one on each side of xylem. In such a vascular bundles there are **two strips of cambium** one on each side of xylem. Only outer cambium is functional.
  Eg.Bicollateral vascular bundles are found in families of **Cucurbitaceae, Solanaceae, Apocyanaceae** etc.

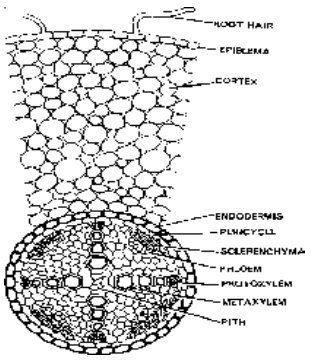
Anatomy of dicotyledonous and monocotyledonous plants

Dicotyledonous Root:

- A thin T. S. of **gram** (*Cicer arietinum*) **root** shows the following structure:
- **(i) Epiblema :** This is also known as the piliferous layer.It is characteristically single layered, comprising **tubular living components**. Cuticle and stomata are **absent**. The outer walls of some cells protrude in the form of **unicellular root hairs**. These hairs perform in **absorption of water** from the soil.
- **(ii) Cortex:** Cortex consists of many layers of thin-walled parenchymatous cells with plenty of intercellular spaces.In some cases, the epiblema soon dies off; a few outer layers of the cortex become **cutinized** and form the exodermis.
- **(iii) Endodermis :** The innermost layer of cortex is the **endodermis** which completely surrounds the **stele**. It comprises a single layer of **barrel-shaped** cells **without inter cellular-spaces**.
- The **tangential** as well as **radial walls** of the endodrmal cells have a deposition of **water impermeable**,**waxy** material **suberin** in the form of **casparian strips**.
- **(iv) Pericycle :** It is made up of thick-walled **parenchymatous cells**. **Lateral root** originates from the **pericycle**. Thus lateral roots are **endogenous** in origin. Initiation of vascular cambium during secondary growth takes place in pericycle cells.
- **(v) Vascular tissues:** These are always arranged in a **ring** and are **radial.**Theprotoxylem is always away from the centre and metaxylem towards the centre.This condition of xylem is called **exarch**.The

number of vascular bundles in dicot is 2-4 (diarch to tetrarch).

- **(vi)Conjunctive tissue :** The **parenchyma** lying inbetween xylem and phloem strands forms the **conjunctive tissue**. Vascular cambium is formed from the conjunctive tissue during the secondary growth.
- **(vii) Pith:** It occupies a **small area** in the centre of the root and consists of parenchymatous cells.
- All the tissues on the innerside of the endodermis such as pericycle,vascular bundles and pith constitute the **stele.**



Detailed structure of a portion of T.S. of *Cicer* root

INTERNAL STRUCTURE OF MONOCOTYLEDONOUS ROOT :

- In a T.S. of the **maize** (*Zea mays*) **root** the following structures are seen:

(i) Epiblema : It is the outermost layer of the root with large number of unicellular hair.

(ii) Cortex : Below the epiblema is present **multilayered parenchymatous tissue** with **intercellular spaces**. It is cortex.

(iii) Endodermis : The **innermost layer** of the cortex is the endodermis. Endodermal cells are **barrel shaped,having casparian strips**.

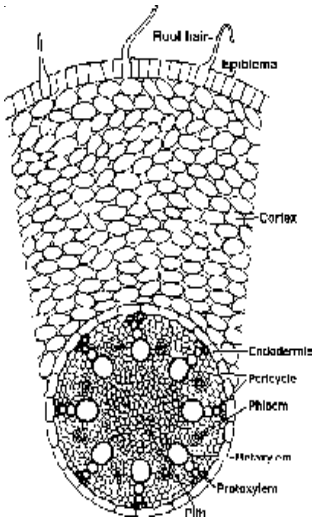
(iv) Pericycle : It is **uniseriate** and is made up of Parenchyma.

(v) Vascular bundle : Vascular bundles are **polyarch, radial** and **exarch. Phloem parenchyma absent**.

(vi) Conjunctive tissue : It is made up of parenchymatous cells inbetween the xylem and phloem.

(vii)Pith : Large, made up of loosely arranged parenchymatous cells with abundant starch grains.

(viii) Monocotyledonous roots do not undergo any secondary growth.



Detailed structure of a portion of T.S. of Maize root

Internal Structure of Dicotyledonous Stems

- The transverse section of the young sunflower (*Helianthus annus*) stem shows the following structure:
- **(i) Epidermis :** Epidermis is the **outermost layer** of stem. It is made up of **single layer of cells** and **lack of chloroplast**.
- **Multicellular hair** trichomes and **stomata** are found on epidermis. A thin layer of cuticle is present on the outside
- **(ii)Cortex:**It can be divided into three sub zones:
- **a) Hypodermis :** It is present just below the epidermis.It is thick **multicellular layer**.This layer is composed of **collenchyma.** It provides mechnical strength to young stem.
- **b) General cortex :** This lies internal to the hypodermis and consists of a few layers round and thin walled, parenchymatous cells.There are

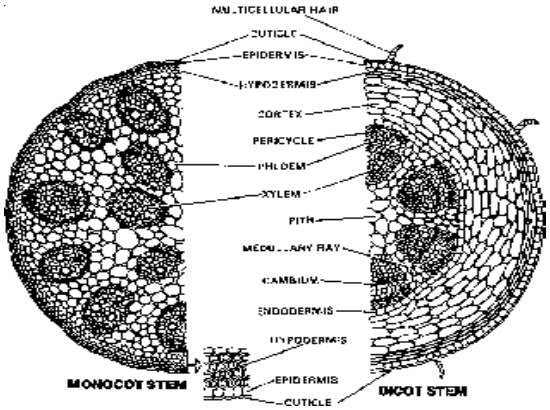
distinct intercellular spaces in it.**Storage of food** is the main function of the cortex.

- **c) Endodermis :** It is **innermost layer** of the cortex.The cells of endodermis are barrel shaped and without intercellular spaces.The cells of endodermis are rich in starch grains and the layer is also reffered to as the **starch sheath.**
- **(iii) Pericycle :** This layer situated inbetween the endodermis and vascular bundles (below the endodermis and above the vascular bundle). The pericycle is a heterogenous layer made up of both parenchymatous and sclerenchymatous cells. Sclerenchyma forms **semi-lunar patches** above the vascular bundles.
- **(iv) Vascular bundles :** The vascular bundles are arranged in a **ring (Eustele)** internal to the endodermis.The **'ring'** arrangement is characteristic of dicot stem. Each vascular bundle is **conjoint, collateral, endarch** and **open**.
- **(v) Medullary rays :** A few layers of big, **polygonal cells** lying in between two vascular bundles are the **medullary rays**.they help in **lateral conduction**.
- **(vi) Pith (medulla):**It extends from below the vascular bundles up to the centre and is composed of **rounded** or **polygonal, thin-walled cells** with **abundant intercellular space** in between them. These cells store **food material** and **water**.

Internal Structure of Monocotyledonous

Stem :

- The internal structure of the young **Maize** *(Zea mays)* **stem**, which is a **monocot** shows the following details in a transverse section:
- **(i) Epidermis :** This is single outermost layer with a thick cuticle.
- **(ii) Hypodermis :** This is formed of sclerenchymatous cells, usually 2-3 layers thick; lying below the epidermis.
- **(iii)Ground tissue :** The entire mass of parenchymatous cells next to hypodermis form ground tissue.Like the dicot stem, it is not differentiated into cortex, endodermis and pericycle. The vascular bundles remain scattered in the parenchymatous ground tissue
- **(iv) Vascular bundles:**Many vascular bundles are **scattered** in the ground tissue. **(Atactostele)** Each vascular bundle is surrounded by a sheath of sclerenchymatous bundle sheath hence vascular bundles are called **fibro vasular bundles.**
- The vascular bundles are conjoint, collateral, endarch and **closed**.They are numerous,smaller and densely arranged towards the periphery but larger and loosely arranged **towards** the centre of the stem.
- Phloem parenchyma is absent in monocot stem**.** A **lysigenous cavity** (water containing cavity), formed by the break down of inner protoxylem vessel and the nearby cells.
- **(v)Pith and stele:**Atactostele is found in monocotyledons. This is highly developed stele. Undifferentiated pith is present in monocotyledon stems.



structure of dicot & monocot stems

Internal Structure of Leaf

- Leaves are of two types
  I.**Dorsiventral leaf :** They are present in dicots. They are more green on adaxial surface and less green on abaxial surface.Its dorsal and ventral surfaces are distinct both morphologically and anatomically.
  E.g. Mango, *Ficus*.
- II. **Isobilateral leaf** : They are present in monocots. They are equally green on both surfaces. Their dorsal and ventral surfaces are not distinct.
  Eg., Wheat, Maize

Dorsiventral (Dicot) Leaf :

- The transverse section of a **Mango leaf** shows the following structures:
- **(i) Upper epidermis (adaxial epidermis) :** This is the outermost layer made of **unilayered parenchymatous cells** attached to one another. The outer wall of the cells are **cuticularized**. Stomata and chloroplasts are very few or absent
- **(ii) Lower epidermis (abaxial epidermis) :** It is a single layer of **parenchymatous cells** with a **thin cuticle**. It contains **numerous stomata**. Chloroplasts are present only in **guard cells**. The lower epidermis helps in the **exchange of gases**.
- The abaxial epidermis generallly bears more stomata than the adaxial epidermis. the latter may even lack stomata.
- **(iii)Mesophyll:** The tissue in between the upper and lower epidermis is called **mesophyll**. It posesses chloroplasts and carries out photosynthesis. This is divided into two regions:

1) Palisade tissue:

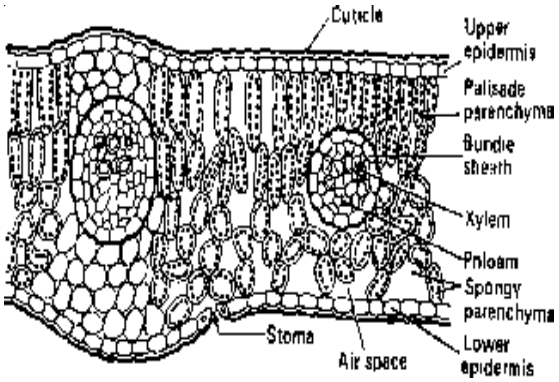
- The cells of this tissue are **elongated.** They are arranged vertically and parallel to each other. These cells have **chloroplasts** and they take part in **photosynthesis**.

2)Spongy parenchyma:

- It is found **below the palisade tissue**. The cells of spongy parenchyma are almost **spherical** or **oval** and are irregularly arranged and extend upto lower epidermis.
- The cells also have **chloroplasts**, and are with intercellular spaces and air cavities between them. Intercellular spaces help in diffusion of gases.

3)Vascular bundles:

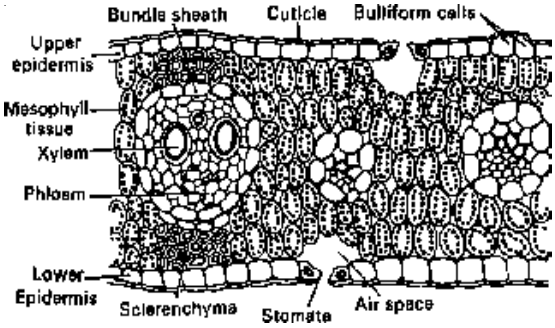
- Size of vascular bundles are dependent on the size of veins. The veins vary in thickness in the recticulate venation of the dicot leaves.
- Vascular bundles can be seen in veins and midrib. The vascular bundle of **midrib is largest**. Vascular bundles are **collateral** and **closed**. Around each vascular bundle is present a sheath of **parenchymatous cells** called **bundle sheath**.
- Each vascular bundle consists of xylem lying towards the upper epidermis and phloem towards the lower epidermis.



dicot leaf

Internal structure of isobilateral leaf (Monocot leaf)

- **(i) Epidermis:** Epidermis present on both adaxial side and abaxial side and covered by cuticle stomata are present on both the surfaces of the epidermis; and they have equal number of stomata.
- In grasses, certain adaxial epidermal cells along the veins modify themselves into **large, empty, colourless cells**. these are called **bulliform cells** or **motor cells**. The leaf surface is **exposed** when these cells are **turgid** and they make the **leaves curl inwards** to minimise water loss when they are **flaccid.**
- **(ii) Mesophyll** The mesophyll is **not differentiated** into palisade and spongy parenchyma. These cells are almost **spherical** and enclose small intercellular spaces and are irregularly arranged. These cells contain chloroplasts.
- **(iii)Vascular bundles :** The parallel venation in monocot leaves is reflected in near similar sizes of vascular bundles (except in main veins).



monocot leaf

SECONDARY GROWTH

- "Secondary growth is increase in girth or diameter of axis (root and stem) of the plant by formation of secondary tissue by activity of lateral meristem (vascular cambium and cork cambium)."
- Secondary growth generally seen in roots and stems of Gymnosperms and dicots.

SECONDARY GROWTH IN DICOT STEM

A.Secondary growth by Vascular cambium

- The vascular bundles in dicot stem are **conjoint, collateral** and **open** and are arranged in a ring. The cambium present between xylem and phloem in vascular bundles is called **fascicular** or **intrafascicular cambium**.
- Some cells of medullary rays (i.e.between vascular bundles) also become **meristematic** and this is called **interfascicular cambium**.
- Both these cambia collectively constitute a complete ring of **vascular cambium** or **intrastelar cambium**.

Activity of the cambialring

- The ring of vascular cambium or true cambium cuts off cells both on outer side and innerside. The cells cut off on outer side are **secondary phloem** and on inner side are **secondary xylem**.
- The cambium is **generally more active on the inner side than the outer side**.
- Amount of secondary xylem cut off is more than secondary phloem and thus with the formation of secondary tissue, **increase in girth** or **diameter** occurs, which is thus called **secondary growth**.

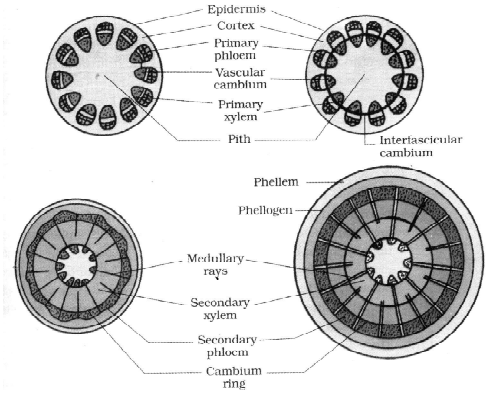


Fig. *Secondary Growth in DICOT STEM : Stages Intransuerse View*

- The structure of secondary xylem and secondary phloem is similar to that of primary xylem and primary phloem. With the increase in secondary tissue, the primary xylem and primary phloem get crushed due to the continuous formation of secondary xylem. The primary xylem however remains more or less intact in or around the centre.
- At some place, the cambium does not form secondary xylem and secondary phloem but form parenchymatous cells instead of xylem and phloem. Thus these cells form continuous strips from secondary xylem to secondary phloem and are called **secondary medullary rays**. These rays are arranged **radially** and pass through secondary xylem and secondary phloem. Primary and secondary medullary rays conduct food, water and minerals from centre to periphery.

Spring wood and Autumnwood

- There is a marked difference in activity of cambium with change in season. It is under the control of many **physiological** and **environmental factors**. In **spring**, the activity of cambium **is more** and hence the wood elements are **larger in size** with **wide lumen**.Moreover, the amount is more and the secondary xylem or wood formed during spring is called a **spring wood** or **early wood.**
- The activity of cambium is **less** during **winter** or **autumn** and the wood elements are **smaller in size** with **narrow lumen**. Moreover, it is lesser in

amount, since cambium is less active and the wood formed during winter or autumn is called **winter** or **autumn wood** or **late wood.**

- **The spring wood** is lighter in colour and has lower density, whereas the **autumn wood** is darker and has a higher density.
- Spring wood and Autumn wood of an year constitute **annual ring**.
- The number of annual rings present at the base of stem can indicate the age of tree.
- The age of tree can be determined by counting annual rings in oldest or basal portion of tree trunk. Calculation of age of the tree by counting annual rings is called **Dendrochronology** or **Growth ring analysis.**

Heart wood and Sap wood

- In perennial woody trees, the central portion of stem is darker in colour. Further it is **hard** and tough due to deposition of resins, oils,aromatic substances and essential oils, tannins,gums and formation of tyloses. This central hard, tough and darker region constitutes heart **wood** or **duramen**. These substances make it hard, durable and resistant to the attacks of micro-organisms and insects. This region comprises of dead elements with highly lignified walls. The conduction function of heart wood stops due to formation of tyloses in vessels and hence heart wood is **mechanical in function**.The heart wood is generally used for **making furniture**. The outer or peripheral portion of the secondary xylem is lighter in colour and is known as, **sap wood** or **alburnum**.

Secondary Growth by Cork Cambium

- In many woody plants further increase in girth takes place by formation of new tissues in extrastelar regions. These new tissues are called **periderm**.Periderm is made up of three tissues
- **(i)Phellogen (=cork cambium) :** It is a **secondary lateral meristem** that may arise from permanent living cells of **hypodermis** or **outer cortex**. It is composed of a **single** layer of meristematic cells. In transverse section the cells appear almost rectangular and **radially flattened**. Its cell divide in a tangential plane, cutting cells towards its inner as well as outer face.
- **(ii) Phellem (=cork):**These cells are formed as a result of tangential and periclinal divisions of phellogen cells towards the outer face. These cells are compactly arranged and have thin cellulose walls in the beginning. As they mature, there is a gradual loss of living matter and cells get elongated **radially, vertically** or **tangentially**. The cell walls become **thick** because of development of fatty substance called **suberin**. Suberin is **impervious to water**.
- **(iii) Phelloderm (=secondary cortex) :**Layers of thin walled cells cut off towards the **inner side** of the phellogen form **phelloderm**. The cells of this layer are **living** and possess **cellulose cell wall**. In some species these cells may contain **chloroplasts** and **starch**. This is also called **secondary cortex**.Phellogen, phellem and phelloderm are collectively known as periderm

Bark

Bark is defined **all the tissues, outside vascular cambium**, so it also includes secondary phloem. Bark = Periderm + Cortex + Pericycle + Primary and secondary phloem. Bark refers to tissue types namely periderm and secondary phloem. Bark that is formed in early season is called **early or** soft bark. Bark which is formed later or at the end of season season is called **late** or **hard bark.**

Lenticels

Lenticels are openings formed in the bark through which exchange of gases takes place. At certain regions, the phellogen cuts off closely arranged parenchymatous cells on the outer side instead of cork cells.These parenchymatous cells (complementary cells) soon rupture the epidermis, forming a lense - shaped openings called lenticels. Lenticels permit the exchange of gases between the outer atmosphere and the internal tissue of the stem. these occur in most woody trees .

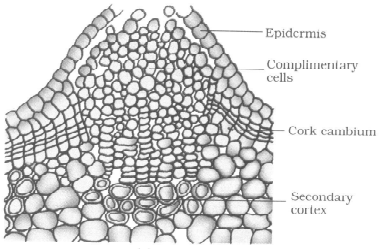


Fig. Lenticel

SECONDARY GROWTH IN DICOT ROOT

- Secondary growth is essential in roots to provide strength to the growing aerial parts of the plants and fulfill the requirement of water and minerals.
- Secondary growth is **not found in monocot roots**.
- It occurs due to the activity of **vascular cambium** and **cork cambium**.

Activity of Vascular Cambium

- The **parenchymatous cells** on the inner side of the phloem become **meristematic** and gives rise to a **strip of cambium**. The **parenchymatous cells** lying in between xylem and phloem bundles also become **meristematic**.
- After this, the portion of the pericycle lying opposite the protoxylem becomes **meristematic** and forms a strip of **cambium**.Thus, a **wavy cambium** is formed extending over the xylem and down the phloem.
- The vascular cambium produced in dicot roots entirely secondary in origin.
- The vascular cambium in root is dual in origin because it is produced from two sources.
  (i) Partly from the conjuctive parenchyma cells and
  (ii) Partly from the cells of pericycle.
- It begins to cut off new cells on both sides but more on the inside. As a result of increased formation of new cells on the inner side the cambium and phloem are pushed outwards.The wavy cambium soon becomes **circular**.
- The whole of the cambium ring behaves in the same way as in the stem, giving rise to the **secondary xylem** on the inside and **secondary phloem** on the outside.The cambium forms **distinct radial bands of parenchyma** against the protoxylem.These are the **primary medullary rays**.
- Some medullary rays are also formed by the cambium along the inner edge of the phloem and are called **secondary medullary rays**.
- The amount of secondary phloem is much less than the secondary xylem.
- The primary phloem gets crushed.

Activity of Cork Cambium

- The cork cambium may develop either from the **pericycle** or the **phloem**.
- The cork cambium produces a few **brownish layers of cork** (phellem) on the **outside** and the **secondary cortex** (phelloderm) on the inside.

MODEL TEST - I

1. Plant Anatomy is the study of
   1) Tissues only 2) Gross internal details
   3) Cell only 4) Cellorganelles
2. Which of the following is not a primary meristem
   1) Procambium 2) Apical meristem
   3) Cork cambium
   4) Intercalary meristem
3. The secondary meristem formed from medullary ray cells is
   1) Intra-fascicular cambium
   2) Cork cambium
   3) Intercalary meristem
   4) Interfascicular cambium
4. The meristem that help in the linear growth of stem and leaves is
   1) Intercalary meristem
   2) Inter fascicular cambium
   3) Lateral meristem 4) Cork cambium
5. The meristem found in growing points of root, stem and branches is
   1) Apical meristem 2) Plate meristems
   3) Intercalary meristems
   4) Intra-fascicular meristem
6. A secondary lateral meristem in plants
   1) Intra fascicular cambium
   2) Cork cambium
   3) Sub-apical meristem 4) Apical meristem
7. Cylindrical meristems are
   1) All lateral meristems 2) All apical meristems
   3) Secondary meristems 4) Primary meristems

8. Meristems that regenerates plant parts removed by the grazing herbivores is
   1) Vascular cambium 2) Cork cambium
   3) Apical meristem 4) Intercalary meristem
9. The secondary lateral meristem that produces secondary xylem and secondary phloem is
   1) Vascular cambium 2) Cork cambium
   3) Fascicular cambium 4) Procambium
10. Curly top virus spread through
   1) Xylem 2) Phloem
   3) Epidermal cells 4) Collenchyma cells
11. Axillary buds capable of forming
   1) Bracnh only 2) Flower only
   3) Leaf 4) 1 or 2
12. Books of Katherine Esau are
   1) Plant Anatomy 2) Anatomy of seed plants
   3) Hybridization in plants 4) Both 1 and 2

MODEL TEST - II

13. Simple living mechanical tissue is
   1) Parenchyma 2) Sclerenchyma
   3) Collenchyma 4) Xylem
14. A simple tissue commonly found in the pulp of fruits like guava and pear is
   1) Parenchyma 2) Collenchyma
   3) (1) & (2) 4) Sclereids
15. A simple tissue absent in roots and monocot stems is
   1) Parenchyma 2) Collenchyma
   3) Sclerenchyma 4) Chlorenchyma
16. Tissues that give mechanical strength are
   1) Collenchyma 2) Sclerenchyma
   3) Parenchyma 4) Both 1 and 2
17. Collenchyma can be differentiated from parenchyma by
   1) Living protoplasm
   2) Pecto-cellulosic deposits at corners
   3) Cellulosic wall 4) No protoplasm
18. Parenchymatous tissue is the seat of
   1) Photosynthesis
   2) Storage of food materials
   3) Secretion and excretion
   4) All of the above
19. Collenchyma differs from sclerenchyma
   1) Retaining protoplasm at maturity
   2) Having thick walls
   3) Having wide lumen
   4) Being meristematic
20. The cells or tissues of plants which have lost the power of division are called
   1) Permanent tissue 2) Promeristem tissue
   3) Protoderm tissue 4) Meristematic tissue
21. Collenchyma tissue is present in
   1) Dicot stem 2) Monocot stem
   3) Dicot root 4) Monocot leaf
22. The chief function of collenchyma is
   1) Storage 2) Mechanical
   3) Assimilation 4) None of these
23. Collenchyma is present in
   1) Herbaceous monocots 2) Herbaceous dicots
   3) All herbaceous plants
   4) Pteridophytes and monocots

MODEL TEST - III

24. Collection of different types of cells that helps in common performance
   1) Tissue 2) Simple tissue
   3) Complex tissue 4) None of these
25. The two components of phloem that originates from a common meristematic cell are
   1) Phloem fibres and phloem parenchyma
   2) Sieve tubes and companion cells
   3) Sieve tubes and sieve cells
   4) Companion cells and Phloem parenchyma
26. The specialised cells in the epidermis of Monocot leaves that help in rolling and unrolling of leaves are
   1) Epithem cells 2) Complementary cells
   3) Bulliform cells 4) Trichoblast cells
27. The only cells in the epidermis with chloroplasts
   1) Trichoblast cells 2) Bulliform cells
   3) Guard cells 4) Subsidiary cells
28. Kidney shaped guard cells are found in the stomata of
   1) Helianthus 2) Wheat 3) Oryza 4) Zea

29. The layer of cortical tissue system that completely surround the stele in roots is
1) Pericycle 2) Hypodermis
3) Endodermis 4) Medulla

30. The special feature of Cucurbitaceae, Solanaceae is
1) Presence of radial vascular bundles
2) Presence of bicollateral vascular bundles
3) Presence of collateral vascular bundles
4) Presence of concentric vascular bundles

31. Phloem cells lack nucleus at maturity are
1) Seive tubes 2) Seive cells
3) Companian cells 4) Both 1 and 2

32. Complex tissue that conducts water and minerals is
1) Xylem 2) Phloem
3) Sclerenchyma 4) Chlorenchyma

33. Complex tissue that conducts organic solutes is
1) Xylem 2) Phloem
3) Sclerenchyma 4) Chlorenchyma

34. Function of sieve tubes are controlled by
1) Sieve cells 2) Phloem fibres
3) Companian cells 4)Phloem parenchyma

35. Mesophyll cells come under
1) Epidermal tissue systems
2) Vascular tissue systems
3) Fundamental tissue systems 4) All of these

MODEL TEST - IV

36. The tissue in monocot root that gives rise to lateral roots is
1) Endodermis 2) Pericycle
3) Medulla 4) Exodermis

37. A conspicuous medulla is seen in
1) Dicot stem, Monocot stem
2) Monocot root, Monocot stem
3) Dicot stem, Monocot root
4) Dicot root, Monocot stem

38. Casparian bads are chemically
1) Pectinised 2) Subarised
3) Cutinised 4) Lignified

39. Presence of caparian bands is a special feature of
1) Endodermis 2) Pericycle
3) Medullary rays 4) Exodermis

40. Semi-lunar patch of sclerenchymatous pericycle is found in
1) Roots of Helianthus 2) Stem of Helianthus
3) Leaf of Zeamays 4) Leaf of Cucurbits

41. The layer in anatomy of Dicot stem which is regarded as starch sheath
1) Pericycle 2) General cortex
3) Endodermis 4) Conjunctive tissue

42. The most advanced character is monocot stem is
1) Presence of sclerenchymatous hypodermis
2) Presence of Atactostele
3) Presence of closed, vascular bundles
4) Absence of medulla, medullary rays

43. The hypodermal layer is collenchymatous in
1) Stems of Zea 2) Roots of Helianthus
3) Stems of Cucurbita 4) Leaves of Zea

44. In the leaves of which plants the dorsal and ventral surfaces are distinct both morphologically and anatomically
1) Wheat and Maize 2) Mango and Ficus
3) Mango and Wheat 4) Ficus and Maize

45. Type of stele in dicot stem
1) Eustele 2) Atactostele
3) Siphanostele 4) Protostele

46. Radial vascular bundles are seen in
1) Roots 2) Stems
3) All parts 4) Leaves

47. Homogenous mesophyll is found in
1) Helianthus leaf 2) Maize leaf
3) Mango leaf 4) Hibiscus leaf

48. Inner most layer of cortex is
1) Endodermis 2) Epidermis
3) Hypodermis 4) Pericycle

49. Outer most stelar layer is
1) Endodermis 2) Epidermis
3) Hypodermis 4) Pericycle

50. Aboundant medulla is seen in
1) Dicot stem 2) Monocot stem
3) Dicot root 4) Both 2 and 3

MODEL TEST - V

51. The meristem that is partly primary and partly secondary in nature in dicot stem is
    1) Vascular cambium 2) Cork cambium
    3) Inter fascicular cambium
    4) Lateral meristem
52. The uniformly thick region in a secondary dicot stem is
    1) Heart wood 2) Spring wood
    3) Autumn wood 4) Sap wood
53. The combination of which two secondary xylem components forms an annual ring
    1) Sapwood and autumn wood
    2) Early wood and late wood
    3) Heart wood and spring wood
    4) Autumn wood and alburnum
54. The secondary meristerm formed by the dedifferentiation of cortical cells is
    1) Interfascicular cambium
    2) Intrafascicuclar cambium
    3) Cork cambium 4) Secondary cortex
55. The innermost layer of bark is
    1) Phelloderm 2) Phellorgan
    3) Vascular cambium
    4) Secondary phloem
56. All the tissues that are formed out side the vascular cambium constitutes
    1) Bark 2) Periderm
    3) Cork 4) Phellogen
57. Loosely arranged, non-submerised parenchyma cells in lenticels are
    1) Epithem cells 2) Complementary cells
    3) Transfusion cells 4) Subsidiary cells
58. Tissues involved in formation of vascular cambium in dicot root is
    1) Pericycle 2) Conjuctive tissue
    3) Xylem 4) Both 1 and 2
59. Wood with less density is
    1) Spring wood 2) Late wood
    3) dark wood 4) Autumn wood
60. Lense shaped strctures of cork helps in gaseous exchange are
    1) Stomata 2) guard cells
    3) Lenticels 4) Motor cells

QUESTION BANK
TEST - 1

61. The persisting embryonic tissue in the plant body is called
    1) Parenchyma 2) Collenchyma
    3) Permanent tissues 4) Meristem
62. The derivatives of apical meristems are
    1) Secondary tissues 2) Primary tissues
    3) Phellogen 4) Phellum
63. Axillary buds are derived from
    1) Shoot apical meristems
    2) Root apical meristems
    3) Lateral meristems
    4) Intercalary meristems
64. The primary meristems that is derived from shoot apical meristems found in between two permanent tissues is called
    1) Lateral meristems
    2) Intercalary meristems
    3) Secondary meristems 4) Phellogen
65. Identify the mismatch from the following
    1) Fascicular cambium – primary meristems
    2) Phellogen – Embryonic meristems
    3) Vascular cambium - Fascicular + Interfascicular cambia
    4) Apical meristems – Primary meristems
66. Dermal tissues, Ground tissues and vascular tissues are derived from
    1) Apical meristems
    2) Lateral meristems
    3) Phellogen
    4) Interfascicular cambium

67. A group of permanent cells which are similar in their structure and function are called
1) Simple tissues
2) Complex tissues
3) Special type of tissues
4) Mechanical tissues

68. Dissimilar permanent tissues collectively performing a common function is called
1) Simple tissues
2)Special type of tissues
3) Complex tissues
4) All of these

69. Number of types of cells present in a simple tissue
1) Many 2) Two
3) One 4) Four

70. The common most simple tissue found in plants is
1) Parenchyma 2) Collenchyma
3) Sclerenchyma 4) Laticiferous tissue

71. The photosynthetic simple tissues are
1) Parenchyma 2) Collenchyma
3) Sclerenchyma 4) 1 & 2

72. The living mechanical tissue is
1) Collenchyma 2) Sclerenchyma
3) Parenchyma 4) Xylem

73. In which of the following simple tissues, the chemical composition of cellwalls is unevenly distributed?
1) Parenchyma 2) Sclerenchyma
3) Collenchyma 4) Sclereids

74. The very young stems of dicots, petioles of leaves and peduncles will not break by external extream wind velocity due to presence of
1) Living mechanical tissues
2) Dead mechanical tissues
3) Parenchyma 4) Phloem

75. The number of types of polysaccharides presence in the cellwalls of collenchyma is
1) 2 2) 4 3) 1 4) 3

76. The chemical composition of cellwalls of living mechanical tissues is
1) Cellulose, Hemicellulose and pectin
2) Cellulose, chitin and pectin
3) Cellulose, pectin and suberin
4) Chitin, cellulose and cutin

77. Food assimilatory simple tissues are
1) Parenchyma 2) Collenchyma
3) Sclerenchyma 4) 1 & 2

78. Which of the following are called cylindrical meristems?
1)All primary meristems
2) All apical meristems
3) All lateral meristems
4) Only intercalary meristems

79. Complex tissues are completely absent in
1) Thallophytes and Bryophytes
2) Thallophytes and pteridophytes
3) Phanerogons and Cryptogams
4) Thallophytes alone

80. Perforation plates are associates with
1) Tracheary elements 2) Xylem vessels
3) Tracheids 4) Xylem parenchyma

81. The main water transporting chanalised elements present in xylem are
1) Tracheids 2) Vessels
3) Parenchyma 4) 1 & 2

82. The only living tissue found in water transporting complex tissue
1) Xylem fibres 2) Xylem parenchyma
3) Vessel members
4) Tracheary elements

83. In tracheophytes, generally occurrence of vessels in xylem is the characteristic feature of
1) All angiosperms 2) Most of the angiosperms
3) All gymnosperms
4) Most of the Gymnosperms and Pteridophytes

84. Devolopment of Endarch xylem is the characteristic feature of
1) Roots 2) Stems
3) Leaves 4) 1 & 2

85. Development of Exarch xylem is the characteristic feature of
1) Stems 2) Roots
3) Leaves 4) Seeds

86. The oldest xylem in primary xylem is
1) Meta xylem 2) Protoxylem
3) Xylem element facing towards the pericycle of the root 4) 2 & 3

87. The living phloem elements bearing primordial utricle along with vacuole and devoid of nucleus are
1) Companion cells and Albuminous cells
2) Matured sieve cells and sieve tubes
3) Phloem parenchyma
4) Phloem fibres

88. In angiosperms the functions of sieve tubes are regulated by
1) The nucleus of albuminous cells
2) The nucleus of companion cells
3) The nucleus of phloem parenchyma
4) The nucleus phloem fibre

89. The intercellular connections present between sieve tubes and companion cells are
1) Pits
2) Pit fields
3) Sieve plates
4) Perforation plates

90. The Sclerenchymatous tissue present in phloem is
1) Phloem parenchyma
2) Bast fibres
3) Sieve tube members
4) Albuminous tissue

91. Apical meristems are absent at the tips of
1) Root 2) Stem
3) Branch 4) Leaf

92. Which of the following meristems helps in linear growth of the stems of grasses?
1) Intercalary meristems
2) Apical meristems
3) Fascicular cambium
4) 1 & 2

93. Generally the primary phloem is devoid of
1) Sieve cells 2) Sieve tubes
3) Phloem parenchyma 4) Phloem fibres

94. Commercial fibres such as Flax fibres and hemp fibres are structurally composed of
1) Sclerenchyma fibres 2) Sclereids
3) Tracheary elements 4) Sieve elements

95. A group of fundamental tissues that behave as a functional unit is called
1) Special tissue 2) Tissue system
3) Secretary tissues 4) Glandular tissues

96. The structure and function of a tissue depends on their
1) Position in plant body 2) Location in the plant body
3) Origin in the plant body
4) 1 & 2

97. Three types of tissue system classification was proposed based on their
1) Shape and size of the tissue
2) Structure and location in the plant body
3) Physiological function of the tissue
4) Nutritional function of the tissue

98. The autotrophic cells generally present in stomatal apparatus are
1) Subsidiary cells 2) Guard cells
3) Accessary cell 4) Helping cells

99. Identify the right match from the following
1) Hypodermis – Epidermal tissue system
2) Pericycle – Vascular tissue system
3) Endodermis – Epidermal tissue system
4) Medulla – Ground tissue system

100. Which of the following tissue systems includes only simple tissues?
1) Epidermal 2) Ground
3) Vascular 4) 1 & 2

101. The living mechanical simple tissue generally absent in
1) Epidermal tissue system
2) Ground tissue system
3) Vascular tissue system
4) 1 & 3

102. The ground tissue system of leaves
1) Xylem 2) Bundle sheath
3) Mesophyll 4) 2 & 3

103. Bicollateral vascular bundles are found in
1) Hibiscus 2) Cucurbita
3) Helianthus 4) Zeamays

104. The ratio of xylem, phloem and cambial patches present in bicollateral vascular bundles respectively is
1) 1 : 1 : 1 2) 2 : 1 : 2
3) 1 : 2 : 2 4) 1 : 2 : 1

105. Collateral and conjoint vascular bundles are found in
1) Dicot stems 2) Monocot stems
3) Dicot roots 4) 1 & 2

106. The characteristics of vascular bundles of dicot roots are
1) Radial, separated, Exarch and polyarch
2) Radial, separated, endarch and polyarch
3) Collateral, closed, exarch and Tetrarch
4) Radial, Seperated, exarch and usually diarch to tetrarch

107. Oval shaped vascular bundles are irregularly scattered in
1) Dicot stem 2) Monocot stem
3) Dicot root 4) Monocot root

108. In dicot and monocot stems, the hypodermal tissue is composed of respectively
1) Parenchyma and Collenchyma
2) Sclerenchyma and Collenchyma
3) Collenchyma and Sclerenchyma
4) Sclerenchyma and Sclerenchyma

109. The most important anatomical characteristic feature generally exists for identification of dicot stem is 1) Presence of top shaped vascular bundles
2) Large number of vascular bundles arranged in the form of a ring
3) Endarch protoxylem in each vascular bundle
4) Occurrence of medulla

110. The general distribution of stomata in the dorsiventral leaf is described as
1) Epistomatous 2) Hypostomatous
3) Amphistomatous 4) Astomatous

111. In mesophytes the mesophyll in dorsiventral leaf is generally
1) Homogenous type
2) Heterogenous type
3) Aerenchyma type
4) Always composed of spongy parenchyma

112. The ratio of types of cells present in the upper epidermal cells of dorsiventral and isobilateral leaves respectively
1) 1 : 2 2) 4 : 3
3) 3 : 4 4) 4 : 5

113. The size of the vascular bundle in dorsiventral leaves from proximal end to distal end is in
1) Increasing order 2) Decreasing order
3) Remains constant throughout
4) Unevenly thickened

114. The primary vertical growth of roots of stems is promoted by
1) Apical meristems
2) Lateral meristems
3) Fascicular vascular cambium
4) Interfascicular cambium

115. The main purpose of secondary growth is
1) To increase the diameter of the stems and roots of all vascular plants
2) To increase the girth of the stems and roots of all phanerogams
3) To increase the girth of the stems of the fruit yielding plants only
4) To increase the girth of the stems and roots of dicots and Gymnosperms

116. Vascular cambium is composed of
1) Intrafascicular cambium and interfascicular cambium
2) Interfascicular cambium and Phellogen
3) Interfascicular cambium and Phelloderm
4) Procambium and phallogen

117. The first step during initiation of secondary growth is
1) Formation of fascicular vascular cambium
2) Formation of interfascicular cambium
3) Formation of vascular cambium
4) Formation of cambial ring

118. Primary xylem and primary phloem develops from
1) Procambium
2) Vascular cambium
3) Fascicular vascular cambium
4) All lateral meristems

119. Secondary xylem and secondary phloem develops from
1) All lateral meristems
2) Procambium
3) Vascular cambium
4) Only Interfascicular cambium

120. The matured secondary xylem is present lateral to
1) Protoxylem
2) Metaxylem
3) Central medullary parenchyma
4) Just inner to the cambium

121. The primary meristems that gives rise to secondary xylem and secondary phloem is
1) Phellogen
2) Fascicular vascular cambium
3) Interfascicular cambium
4) Procambium

122. Recently developed secondary xylem and secondary phloem is placed
1) Just inner and outer sides of the vascular cambium respectively
2) Xylem is lateral to metaxylem and phloem lateral to metaphloem
3) Xylem lateral to protoxylem and phloem lateral to semiluxer pericyclic patch
4) Xylem elements are placed lateral to medulla and phloem lateral to primary phloem

123. During secondary growth, the vascular tissue that disintegrates earlier is
1) Primary xylem
2) Primary phloem
3) Medulla 4) Phelloderm

124. The direction of growth of secondary medullary rays takes place by
1) Centripetally 2) Centrifugally
3) Both 1 & 2 4) Radially

125. The first annual ring was developed in 2005 and continuous yearly till 2013. The early wood of 2010 is found between
1) Autumn wood of 2009 and Autumn wood of 2010
2) Springwood of 2010 and spring wood of 2011
3) Spring wood of 2010 and Autumn wood of 2011
4) Autumn wood of 2010 and latewood of 2011

126. Annual rings are well organized in
1) Tropical trees 2) Tropical grasses
3) Temperate trees 4) Temperate plants

127. The applied branch of science that deals with the study of the structure, development, counting number of annual rings and determining the age of the plants is called
1) Dendrology 2) Dendrochronology
3) Phenology 4) Climatology

128. The lighter and darker density woods respectively
1) Autumn wood and spring wood
2) Spring wood and autumn wood
3) Early wood and late wood
4) 2 & 3

129. The non-functional wood with different storage materials resistant to microbes and insects and provides mechanical support to the stem is
1) Sap wood 2) Heart wood
3) Duramen 4) 2 & 3

130. The wood present just inner to the vascular cambium is
1) Functional wood 2) Sap wood
3) Heart wood 4) 1 & 2

131. Generally the number of layers present in a phallogen is
1) 4 2) 3 – 6
3) 2 4) 1

132. The derivatives of phellogen are
1) Phellem towards periphery and phelloderm towards the centre
2) Phelloderm towards periphery and phellem towards the center
3) Both phellem and phelloderm towards periphery
4) Both phellem and phelloderm towards the centre

133. The bark formed in early and late seasons are called respectively
1) Hard bark and soft bark
2) Soft bark and hard bark
3) Ring bark and scale bark
4) Hard bark and soft bast

134. The primary function of lenticels is
1) Exchange of gases
2) Lenticular transpiration
3) Entry and exist of microbes
4) Storage of food materials in their complimentary cells

135. During secondary growth of dicot roots, the vascular cambium originates from
1) Completely primary in origin
2) Completely secondary in origin
3) Partially primary and partially secondary in origin
4) Depends on seasonal and determines either primary or secondary in origin

136. In dicot roots, during secondary growth, the vascular cambium is derived from
1) Conjunctive tissue and perycyclic tissue by differentiation
2) Conjunctive tissue and pericycle by dedifferentiation
3) Conjuctive tissue and pericycle by redifferentiation
4) Medullarly tissue and pericycle by dedifferentiation

137. During secondary growth, initially wavy ring type of vascular cambium is developed in
1) Dicot stem 2) Dicot root
3) Monocot stem 4) Monocot root

138. Presence of pits is the character feature of following simple tissue
1) Parenchyma
2) Collenchyma
3) Sclerenchyma 4) All of these

139. Collenchyma can be differentiated from parenchyma by
1) pecto cellulosic deposits at corners
2) Living protoplasm
3) cellulosic cell wall
4) No protoplasm

140. Collateral bundles occurs in
1) Dicot stem 2) Monocot stem
3) both dicot, monocot stem
4) root

141. Continuous collenchymatous hypodermis and discontinuous sclerenchyma in the pericycle are found in
1) Cucurbita 2) Zea mays
3) Helianthus 4) Oryza

142. Dead, lignified sclerenchyma cells are present in the
1) Hypodermis of dicot leaf
2) Pericycle of monocot root
3) Hypodermis of monocot stem
4) Medulla of dicotstem

143. Largest number of chloroplasts in the leaf is in
1) Spongy tissue
2) Palisade tissue 3) Guard cells
4) Bundle sheath

144. The meristem which occurs between mature tissues in known as
1) intercalary meristem 2) apical meristem
3) lateral meristem 4) all

145. Which one contains vascular bundles in a ring(Eustele)
1) Wheat 2) Lily
3) Sunflower 4) Onion

146. Position and nature of bulliform cells
1) abaxial, large, empty, colour less cells
2) abaxial, small, empty, colour less cells
3) adaxial, large, empty, colour full cells
4) adaxial, large, empty, colour less cells

147. When secondary growth is initiated in dicot stem, what will happen first
1) The cells of cambium divide periclinally to form xylem mother cells
2) Inter fascicular cambium joins with intrafascicular cambium
3) Parenchymatous cells present between vascular bundles become meristematic
4) Medulla gets obliterated

148. The mode of arrangement of palisade parenchyma cells in dicot leaf
1) Vertical rows and parallel to each other
2) Radial rows and parallel to each other
3) Radial rows and perpendicular to each other
4)Vertical rows and perpendicular to each other

149. In a secondary dicot stem the position of youngest secondary phloem is
1) Just outside to vascular cambium
2) just inside to primary phloem
3) just inside to vascular cambium
4) just outside to primary phloem

150. Find out the **correct** statement with respect to secondary growth
1) Autumn wood of 14th Annual ring is lie immediately inside to spring wood 13th Annual ring
2) Spring wood of 8th annual ring is lie immediately inside to autumn wood of 9th annual ring
3) Autumn wood of 16th annual ring is lie immediately outside to spring wood of 15th annual ring
4) spring wood 4th annual ring is lie immediately outside to autumn wood of 3rd annual ring

151. Vascular bundles are conjoint, endarch and lack cambium between xylem and phloem in all, but not in 1) Maize 2) Jowar
3) Wheat 4) Sunflower

152. Find the correct statement from the following
1) Linear growth of the root is maintained by root apical bud
2) Apical growth in monocot stems is due to intercalary meristems and Apical meristems
3) All Apical and Intercalary meristems are primary meristems
4) Axillay buds of leaves are formed by lateral meristems

153. Nature of xylem fibers is
1) Thickened walls, always septate and obliterated lumen
2) Lightly thickened walls, septate or aseptate and broad lumen

3) Highly thickened walls, septate or aseptate and obliterated lumen
4) Highly thin walls, always aseptate and broad lumen.

154. Correct statements related to cells of non living simple tissue
1) Tissue made up of short, wider cells with thick and subarised cell walls.
2) Fibres are elongated cylindrical cells,those occurs always in isolated form.
3) The sclereids are spherical, oval or cylindrical, slightly thickened dead cells.
4) Scelerenchyma provides mechanical support to plant organs.

155. Motor cells belong to
1) Dermal tissue system of Monocot stem
2) Ground tissue system of Monocot leaf
3) Dermal tissue system of Dicot leaf
4) Dermal tissue system of monocot leaf

156. Dicot stem has
1) Conjoint, Collateral, Open, Endarch vascular bundles
2) Conjoint, Collateal, Open, Exarch vascular bundles
3) Conjoint, Collateral, Closed, Endarch vascular bundles
4) Separate, Collateral, Open, Exarch vascular bundles

157. The major component within a plant organ among the following is
1) Parenchyma 2) Collenchyma
3) Sclerenchyma 4) Xylem

158. Identify the incorrect expression from the following statements:
1) All apical meristems are the primary meristems
2) All primary meristems are apical meristems
3) All intercalary meristems are Primary meristems
4) All secondary meristems are lateral meristems

159. Meristems are
1) group of young immature cells
2) group of mature differentiated cells
3) group of immature non-dividing cells
4) group of mature storage cells

160. Ephemeral meristems is
1) Intercalary meristem 2) Apical meristem
3) Lateral meristem 4) All

161. Active cell divisions are found in
1) Latex 2) Pith
3) Internode 4) Root and shoot tips

162. Length of a plant increases due to the activity of
1) Apical meristem
2) Reproductive meristem
3) Secondary meristem
4) Lateral meristem

163. Monocot stem possess
1) lntercalary meristem 2) Lateral meristem
3) Apical meristem 4) 1 & 3

164. Eustele is characteristic of
(1) Monocots 2) Dicots
(3) Pteridophytes 4) Bryophytes

165. Albuminous cells occur in
1) Xylem 2) Phloem
3) Cortex
4) Conjunctive parenchyma

166. Sieve tubes are suited for translocation of food because they possess
1) Bordered pits 2) No ends walls
3) Broader lumen and perforated cross walls
4) No protoplasm

167. Angiosperms contain
1) No sieve tubes 2) No vessels
3) Tracheids only 4) Tracheids and Vessels

168. Companion cells are usually seen associated with
1) Fibres 2) Tracheids
3) Vessels 4) Sieve tubes

169. Xylem conducts water from
1) Leaves to root 2) Root to leaves
3) Tracheids to vessels
4) Fibres to tracheids

170. In which of the following phloem occurs in two patches ?
1) Maize 2) *Cucurbita*
3) Sunflower 4) *Dracaena*

171. External protective tissues of plants or dicot stem are
1) Cork and pericycle
2) Cortex and epidermis
3) Pericycle and cortex
4) Epidermis and cork

172. Cork cells are
1) Dead 2) Photosynthetic
3) Elongated and participate in movement
4) Meristematic

173. Which structure is not present in the leaf of Bean plant?
1) Phloem 2) Stomata
3) Guard cells 4) Lenticels

174. Another term for cork tissue is
1) Phellogen 2) Phelloderm
3) Phellum 4) Periderm

175. Largest number of chloroplasts in the leaf is in
1) Spongy tissue 2) Palisade tissue
3) Guard cells 4) Bundle sheath

176. The lacuna in the vascular bundles of monocot stems is
1) Metaxylem
2) A mucilage cavity
3) Water cavity
4) A large sized vessel

177. Dicot root can be identified by
1) Exarch xylem
2) Absence of pith and endodermis
3) Presence of more than 8 radial bundles
4) Occurrence of 2—6 radial bundles

178. A major part of dicot wood is filled with tannins, resins and gums. It is
1) Sap wood 2) Heartwood
3) Soft wood 4) Hard wood

179. Which would do the maximum harm to the tree if the following is lost?
1) Bark 2) Half the flowers
3) All the leaves
4) Half of the branches

180. Cork cells are impervious due to deposit of
1) Cutin 2) Lignin
3) Suberin 4) Chitin

181. Leaves possess thick cuticle in plants of
1) Warm habitats 2) Dry habitats
3) Cool habitats 4) Wet habitats

182. At maturity which of the following is anucleate:
1) Sieve tubes 2) Cortical cell
3) Palisade cell 4) Companion cell

183. Whose living cells provide tensile and mechanical strength:
1) Collenchyma 2) Sclerenchyma
3) Phloem 4) Sclereids

184. Nucleated part of phloem is
1) Phloem fibre 2) Companion cell
3) Sieve element 4) All of the above

185. An elongated living cell attached with sieve tubes is not found in:
1) Angiosperms 2) Gymnosperms
3) In both angiosperms and gymnosperms
4) None of these

186. The narrow layer of thin walled cells which separate the wood from phloem in dicotyledonous plant is:
1) Endodermis 2) Pericycle
3) Vascular cambium 4) Cork cambium

187. Most appropriate definition of tissue is
1) They are composed of only one type of cells
2) Only one type of cells responsible to perform one common function is called tissue
3) A group of one or more types of cells performing one common function is called tissue
4) none of the above

188. Which one of the following is an effective tissue of growing organs with sufficient elasticity
1) Parenchyma 2) Collenchyma
3) Sclerenchyma 4) All the above

189. The only plant cells without nuclei among the following are
1) Cambium cells 2) Cells of pericycle
3) Xylem parenchyma 4) Sieve tubes

190. Complex tissues include
1) Collenchyma 2) Apical Meristem
3) Conducting tissue 4) Idioblast

191. Layer of cells between endodermis and vascular bundles is called
1) Epidermis 2) Pericycle
3) Hypodermis 4) Pith

192. Vascular bundles in which phloem is found on both sides of xylem are called (In which of the following phloem occurs in two patches)
1) Collateral 2) Bicollateral
3) Radial 4) Amphicribral

193. Exarch and polyarch vascular bundles occur in
1) Monocot stem 2) Monocot root
3) Dicot stem 4) Dicot root

194. In monocot leaf
1) Bulliform cells are absent from the epidermis
2) Veins form a network
3) Mesophyll is well differentiated into these parts
4) Mesophyll is not differentiated into palisade and spongy parenchyma

195. Well developed pith is found in
1) Monocot stem and dicot root
2) Monocot and dicot stems
3) Dicot stem and dicot root
4) Dicot stem and monocot root

196. Generally hypodermis in monocots is composed of
1) Parenchyma 2) Sclerenchyma
3) Collenchyma 4) Chlorenchyma

197. Endodermis of dicot stem is also called
1) Bundle sheath 2) Starch sheath
3) Mesophyll 4) Pith

198. Collenchymatous hypodermis is the characteristics of
1) Dicot stem 2) Monocot stem
3) Monocot as well as dicot stem
4) Hydrophytes

199. In leaves the protoxylem elements
1) Face towards abaxial surface
2) Face towards adaxial surface
3) Are surrounded by metaxylem elements
4) Are scattered in the vascular bundle

200. In what respect, the pericycle of a root differs from that of the stem
1) Sclerenchymatous in root and collenchymatous in stem
2) Collenchymatous in root and parenchymatous in stem
3) Parenchymatous in root and sclerenchymatous in stem
4) Parenchymatous in root and collenchymatous in stem

201. In dicot stem, the secondary growth takes place by
1) Primary cambium
2) Secondary cambium
3) Development of cambium in stele region
4) Development of cambium in stele and in the cortical region

202. "Sap wood" is otherwise called
1) Duramen 2) Alburnum
3) Pith 4) Medullary rays

203. Other names of secondary cortex, cork cambium and cork are
1) Phellem, phelloderm and phellogen
2) Phellogen, phellem and phelloderm
3) Phelloderm, phellogen and phellem
4) Phellogen, phelloderm and phellem

204. Youngest layer of secondary xylem in wood of dicot stem is located just
1) Outside the cambium
2) Inside the cambium
3) Outside pith 4) Inside the cortex

205. Tissue present in an annual ring is
1) Secondary xylem and phloem
2) Primary xylem and phloem
3) Secondary xylem only
4) Primary phloem and secondary xylem

206. Dendrochronology is the study of
1) Height of a tree
2) Diameter of a tree
3) Age of a tree by counting the number of annual rings in the main stem
4) None of these

207. In old dicot stems, a major part of the wood is filled up with tannins, resins, gums etc. This part of wood is called
1) Hard wood 2) Heart wood
3) Sap wood 4) Soft wood

208. Each annual ring has
1) An inner layer and an outer layer
2) A single layer of xylem elements
3) Uniform layer of xylem elements
4) Many layers of xylem elements

209. Cuticle is absent in
1) Roots 2) Stem
3) Leaves 4) In all aerial parts

210. Specialised epidermal cells with chloroplast
1) Subsidiary cells 2) accessory cells
3) Guard cells 4) 1 and 2

211. Stomatal apparatus constitute
1) Stoma & Guard cells
2) Stoma and accessory cells
3) Guard cells and subsidiary cells
4) Stoma, guard cells and subsidiary cells

212. In grasses, the guard cells are
1) Bean - shaped 2) Reniform
3) Dumb-bell shaped 4) 1 & 2

213. If xylem and pholem are situated at the same radius of vasalar bundle, such condition is called
1) Conjoint 2) Collateral
3) Bicollateral 4) All

214. The inner most layer of the cortex is called
1) Hypodermis 2) Endodermis
3) Pericycle 4) Epidermis

215. In dicot root pericycle produce
1) Lateral roots 2) Cork combium
3) Vascular cambium 4) all

216. In T.S of root the tissue present between xylem and pholem is
1) Medulla 2) Medullary rays
3) Conjuctive tissue 4) Pericycle

217. Minimum number of vascular bundles in monocot root are
1) 6 2) 7 3) 8 4) 9

218. In monocot stem peripheral vascular bundles are
1) Larger 2) Smaller
3) Both larger & Smaller 4) None of these

219. In monocot stem one of the following component of pholem is absent
1) sieve cells 2) Sieve tubes
3) Companion cells 4) Phloem parenchyma

220. In leaf anatomy the size of the vascular bundles is dependent on the size of
1) Limina 2) Vein
3) Veinlets 4) 1 & 2

221. When bulliform cells become flaccid, they make the leaves
1) Curl inwards to minimise water loss
2) Curl inwards to rise water loss
3) Curl outwards to minimise water loss
4) Curl outwards to rise water loss

222. In dicot stem vascular cambium is
1) Primary meristem only
2) Secondary meristem only
3) Partly primary & parthy secondary meristem
4) None of these

223. Identify the correct characters of early wood
1) Lighter in colour 2) Lower density
3) higher density 4) 1 & 2

224. All tissues which are found exterior to the vascular cambium is
1) Bark 2) Cork 3) Phellem 4) Phellogen

225. Apical meristems are :
1) Primary meristem 2) Secondary meristem
3) Promeristem 4) None of these

226. Interfascicular cambium in stem is
1) Primary meristem
2) Secondary meristem
3) Promeristem 4) All of these

227. Phellogen is
1) Apical meristem 2) Intercalary meristem
3) Lateral meristem 4) None of these

228. In dicotyledonous leaves, stomata are.
1) Arranged in straight rows
2) Scattered 3) Absent
4) None of the above

229. Sclerenchymatous hypodermis is present in
1) Dicot stem 2) Monocot stem
3) Both 1 and 2 4) None of these

230. Which is commonly known as 'starch sheath'?
1) Pericycle 2) Endodermis
3) Epidermis 4) Hypodermis

231. Conjunctive tissue is present.
1) Between xylem and pholem strands
2) Between metaxylem and protoxylem
3) In cortex 4) In pith

232. Which is not character of stem ?
1) Conjoint, collateral vascular bundles
2) Endarch condition
3) Usually chlorenchyma present
4) Hairs are unicellular

233. Bundle sheath is present around vascular bundles in
1) Monocot stem 2) Dicot stem
3) Both 1 and 2 4) None of these

234. Isobilateral leaves are
1) Hypostomatic 2) Epistomatic
3) Amophistomatic 4) None of these

235. Vascular cambium cuts
1) Secondary xylem on inner side
2) Secondary phloem on outer side
3) Both secondary xylem and secondary phloem on both sides
4) Secondary xylem on inner side and secondary phloem on outer side

236. No secondary growth appears in monocot stems, because
1) Vascular bundles are scattered
2) Vascular bundles closed
3) Vascular bundles enclosed by sclerenchymatous
4) None of the above

237. The cross section of a trunk of tree shown 50 annual rings, the age of tree is
1) 25 years 2) 50 years
3) 100 years 4) 50 months

238. Alburnum is
1) Heart wood 2) Sap wood
3) Hard wood 4) Soft wood

239. Function of duramen is
1) Conduction 2) Mechanical
3) Both 1 and 2 4) None of these

240. Periderm is made of
1) Cork and secondary cortex
2) Cork cambium, cork and secondary phloem
3) Cork cambium, cork and secondary cortex
4) Cork alone

241. Bark of a tree comprises
1) All tissues outside vascular cambium
2) All tissues outside cork cambium
3) Cork, secondary cortex
4) Only cork

242. Autumn wood can be distinguished from spring wood by
1) Broad vessels and tracheids
2) Narrow vessels and tracheids
3) Red colour 4) By cambium

243. Sieve tubes and companion cells are found in
1) Xylem 2) Phloem
3) Meristems 4) Cortex

244. Cortex and pith are not distinguished in
1) Monocot stem 2) Monocot root
3) Dicot stem 4) Dicot root

245. The basic difference between stem and root is that stem is
1) Endarch 2) Exarch
3) Mesarch 4) Polyarch

246. Wood is common name for
1) Vascular bundles
2) Secondary xylem
3) All tissues which form a plant body
4) Phloem

247. Sapwood is synonymous with
1) Outer part of secondary xylem
2) Inner part of secondary xylem
3) Periderm 4) Bark

248. After two years of secondary growth, cortex of a dicot root and stem is
1) Unaffected completely 2) Sloughed off
3) Largely lost
4) Converted into cork

249. Cambium causes growth in
1) Girth 2) Periphery
3) Leaves 4) Length

250. Collateral bundles occur in
1) Dicot stem only 2) Monocot stem only
3) Dicot as well as monocot stems
4) Leaves only

251. The living mechanical tissue of a dicot plant is
1) Parenchyma 2) Collenchyma
3) Sclerenchyma 4) Chlorenchyma

252. All the xylem elements, when mature, are dead except
1) Tracheids 2) Vessels
3) Xylem parenchyma 4) Xylem fibres

253. When xylem has phloem on two sides, the vascular bundle is known as
1) Endarch 2) Exarch
3) Bicollateral 4) Collateral

254. The cork of dicots is a derivative of
1) Phellogen 2) Vascular combium
3) Phloem 4) Xylem

255. Branch of Botany dealing with the internal organization of plants is
1) Physiology 2) Ecology
3) Anatomy 4) Cytology

256. Bast fibres are frequently found in
1) Secondary xylem 2) Secondary pholem
3) Primary phloem 4) Primary xylem

257. Radial exarch condition occurs in
1) Leaf 2) Root
3) Maize stem 4)Fern stem and Petiole

258. Phloem parenchyma is absent in
1) Dicot stem 2) Dicot leaf
3) Monocot stem 4) Dicot root

259. Intercalary meristem results in
1) Secondary growth 2) Primary growth
3) Apical growth 4) Periderm formation

260. Stelar region (vascular tissue, pericycle and pith) are formed from
1) Periblem 2) Plerome
3) Dermatogen 4) Tunica

261. In submerged hydrophytes, stomata are found (CPMT 1990)
1) On upper surface of leaf
2) On lower surface of leaf
3) On both surface of leaf
4) No where on the plant

262. Meristematic activity is at its maximum in the
1) Stem apex 2) Bud
3) Leaf 4) Root hair

263. The cell functionally associated with sieve tube is
1) Phloem fibres 2)Phloem parenchyma
3) Companion cell 4) Collenchyma

264. Primary growth is caused by (or) the length of a plant axis increases by .
1) Apical meristem 2) Lateral meristem
3) Dermatogen 4) Plerome

265. Thickening of cell wall, lignification and specialisation for mechanical function are characteristics of .
1) Sclerenchyma 2) Collenchyma
3) Chlorenchyma 4) Parenchyma

266. An elongated cell with tapering ends is termed.
1) Collenchyma 2) Vessel
3) Sclerenchyma 4) Tracheids

267. Epidermal outgrowths are known as.
1)Trichomes 2) Leaves
3) Stomata 4) Buds

268. Mesophyll is well differentiated in.
1) Dicot leaves 2) Monocot leaves
3) Submerged hydrophytes.
4) Halophytic stems

269. Which side of a bifacial (dorsiventral) leaf possesses more stomata?
1) Adaxial side 2) Abaxial side
3) Present on tip and margins only.
4) None of these

270. Largest amount of chloroplast in the leaf is in
1) Spongy tissue 2) Palisade tissue
3) Guard cells 4) Bundle sheath cells

271. T.S. of a material exhibits conjoint collateral, endarch and closed bundles scattered in a ground tissue. What should be the material ?
1) Monocot root 2) Dicot root
3) Monocot stem 4) Dicot stem

272. Periderm is formed from
1) Vascular cambium 2) Cork cambium
3) Fascicular cambium
4) Interfascicular cambium

273. Well developed pith is found in.
1) Monocot root and monocot stem
2) Monocot root and dicot stem
3) Monocot stem and dicot root
4) Dicot stem and dictot root

274. In old dicot stems a major part of the wood is filled up with tannins, resins, gums, etc., this part is called .
1) Heart wood 2) Sap wood
3) Hard wood 4) Self wood

275. A timber merchant told his customer that log of wood which he was purchsing comes from a 20 years old tree, he told so by inspecting the
1) Diameter of log
2) Thickness of the heart wood
3) Number of cork layers 4) Growth rings

276. In trees the growth rings represent.
1) Primary xylem 2) Secondary xylem
3) Secondary phloem 4) Cambium

277. Lenticel is a loose mass of cells in cork tissue meant for.
1) Protection 2) Respiratory exchange of gases
3) Absorption of moisture from air
4) Exclusion of germs

278. Annual rings are the bands of
1) Secondary cortex and cork
2) All secondary vascular tissues
3) Secondary xylem and xylem rays
4) Secondary phloem and medullary rays

279. Phellogen or cork cambium originates from
1) Interfascicular cambium
2) Intrafascicular cambium
3) Vascular cambium 4) Cortex

280. In dorsiventral leaf, the location of phloem and palisade tissue is
1) Adaxial side 2) Adaxial side
3) Adaxial and abaxial side respectively
4) Abaxial and adaxial side respectively

281. The youngest layer of secondary phloem in a dicot stem is
1) Inside the primary phloem
2) Just outside the xylem
3) Outside vascular cambium
4) Inside vascular cambium

282. To which question the answer is negative ?
1) Do some epidermal cells have chloroplast
2) Do each tissue has a characteristic position of structures
3) Are all dicot leaves dorsiventral
4) Does the root cortex contain sclerenchyma

283. Why is cambium considered a lateral meristem
1) Because it gives rise to lateral branches
2) Because it causes growth in girth
3) Because it increases height and diameter of a plant
4) Because it adds bulk to a plant

284. Angiosperms have
1) Vessels absent 2) Tracheids only
3) Vessels present 4) Sieve tubes absent

TYPE - II

285. Growth in higher plants is largely confined to
I) Shoot apex only
II) Root apex only III) Intercalary meristems only IV) The sites of meristems found the plant body
1) I alone is correct
2) II and III only are correct
3) IV alone is correct
4) I, II, III & IV are correct

286. Which of the following are examples for primary meristems
I) Apical meristems
II) Intercalary meristems
III) Embryonic meristems
IV) The meristems formed by de differentiated method
1) I & II alone 2) II & III alone
3) IV alone is incorrect
4) I, II, III and IV are correct

287. The cylindrical growth of the stems and roots is promoted by
I) Fascicular vascular cambium
II) Interfascicular cambium
III) Cork cambium
IV) Phellogen
1) I alone is correct 2) III alone is correct
3) II alone is correct
4) I, II, III & IV are correct

288. Secondary tissues are produced from
A) Phellogen
B) Interfascicular cambium
C) Intrafascicular cambium
D) De differentiated cambium of cortial tissue
1) A 2) C
3) B 4) A B C D

289. Which of the following statements are true with reference to the characteristics of dead mechanical tissues?
I) These are without protoplastic cells bearing a sapvacuoles
II) These are without protoplastic cells bearing lumen with lignified thickened cellwalls and generally exhibits angular shaped in their T.S.
III) These are devoid of intercellular spaces and bearing a few or numerous pits on their walls
IV) Sclerenchyma has two distinct types of cells such as fibres and sclereids
1) I alone is correct
2) II alone is correct
3) III & IV alone are correct
4) I alone is incorrect

290. The phloem elements present in angiosperms are
I) Sieve tube elements
II) Companion cells
III) Phloem parenchyma
IV) Phloem fibres

1) I alone is correct
2) I & II alone are correct
3) I, II, III & IV are correct
4) II alone is incorrect

291. The phloem elements present in the naked seed bearing plants
I) Sieve cells II) Sieve tubes
III) Albuminous cells IV) Companion cells
1) I & III alone 2) II & IV alone
3) I & IV alone 4) I, II, III & IV

292. Study the following statements and identify the correct one
I) All monocot plants have well developed phloem parenchyma in their phloem
II) Most of the monocots, poorely developed phloem parenchyma in their phloem
III) In most of the monocots, phloem is devoid of phloem parenchyma
IV) In most of the monocots phloem is devoid sieve tubes
1) I & II 2) II & IV
3) Except – III all are incorrect
4) IV alone

293. The cellular components of stomatal apparatus are
A) Guard cells B) Subsidary cells
C) Stomatal aperture
D) Epidermal layer surrounding the subsidiary cells
1) A & B only 2) B & C only
3) ABC only 4) ABCD

294. Study the following statements and select the correct statements
A) The epidermal appendages developed on the different parts of the shoot system are called trichomes or hairs B) The trichome generally are multicellular
C) The trichomes may be branched or unbranched
D) The trichomes may be soft or stiff or even glandular and secretory in their nature
E) Trichomes help in preventing water loss due to transpiration
1) A C D are correct 2) B D E are correct
3) A B C D E are correct
4) A & E only are correct

295. In which of the following epidermal tissue systems stomata are absent?
I) Epidermal tissue system of underground parts
II) Epidermal tissue system of submerged hydrophytes
III) Epidermal tissue system of succulent xerophytes
IV) Epidermal tissue system of mesophytes
1) I alone 2) II alone
3) III & IV alone 4) I & II alone

296. Complex tissues are absent in
I) Ground tissue system
II) Epidermal tissue system
III) Vascular tissue system
1) I alone 2) II alone
3) III alone 4) I & II alone

297. Open vascular bundles are generally present in
I) Dicot stems II) Dicot roots
III) Gymnospermic stems
IV) Gymnospermic roots
1) I alone 2) I & III alone
3) I, II, III & IV 4) II & IV alone

298. The stelar ground tissue system includes
A) Medulla B) Medullary rays
C) Pericycle D) Endodermis
1) B C D 2) A B
3) A B C 4) A B C D

299. Identify the correct statements with regard to the structure and function of vascular bundles of dicot stem
A) Collateral, conjoint, open, exarch and helps in primary growth

B) Collateral, conjoint, open, endarch and helps in secondary growth
C) Radial, separated, endarch and helps in secondary growth
D) Collateral, conjoint, closed, endarch and helps in secondary growth
1) A & D 2) A & B
3) Except B all are incorrect
4) D only

300. The air tight and waterdam structure present in the anatomy of roots is
I) The last layer of the cortex
II) The layer of the cortex present outer to the pericycle
III) The layer Impermeable to the water present outer to the stale
IV) The casparian banded layer present outer to the pericycle
1) I alone is correct
2) III & IV only are correct
3) I, II, III & IV are correct
4) IV alone is correct

301. Arrange the following parts in ascending order with reference to size of the medulla
A) Dicot root B) Monocot stem
C) Dicot stem D) Monocot root
1) B A D C 2) B D A C
3) A B C D 4) D B A C

302. Arrange the following in decreasing order with reference to number of vascular bundles present in them
I) Dicot stem II) Monocot stem
III) Dicot root IV) Monocot root
1) III II I IV 2) II I IV III
3) III II I IV 4) IV II I III

303. Starch layer is absent in
I) Dicot leaf II) Isobilateral leaf
III) Helianthus leaf IV) Zeamays stem
1) IV alone
2) Except IV all are correct
3) I, II, III & IV are correct
4) I & II only are correct

304. Medullary rays are absent in
I) Dicot stem II) Dicot root
III) Monocot stem IV) Monocot root
1) I & II only 2) III & IV only
3) Except I all are incorrect
4) Except III all are incorrect

305. With reference to the anatomy of monocot stem, the following all statements are true except
A) The vascular bundles are collateral, conjoint and closed
B) The development of vascular bundles takes place by centrifugally
C) Each vascular bundles is associated with lysigenous cavity
D) Each vascular bundle is enclosed by parenchymatous bundle sheath
E) In phloem, phloem parenchyma is well developed
1) A B C D 2) A C
3) D E 4) B D E

306. Repeatedly irregularly branched vascular tissues are found in
I) Isobilateral leaf
II) Dorsiventral leaf
III) Zeamays leaf
IV) Helianthus leaf
1) I & III 2) II & IV
3) III alone 4) IV alone

307. In grasses the opening and closing of leaf blade is regulated by
I) Dumbbell shaped guard cells
II) Bulliform cells
III) Motor cells IV) Bundle sheath
1) Except I all are incorrect
2) II & III alone are correct
3) IV alone is correct
4) I, II, III & IV are correct

308. According to non-technical term of the bark, the components of the bark are
I) Secondary phloem
II) Periderm III) Early wood
IV) Phellogen and phellum
1) III & IV 2) II & III
3) I & II 4) I, II, III & IV

309. Select correct statement with respect to trichomes in shoot system
a) Usually unicelled
b) Branched or unbranched

c) May be secretary d) Soft or stiff
e) Helps against transpiration
f) Part of fundamental tissue system
1) b,c,d,e,f 2) b,c,e only
3) b,c,d,e only 4) a,b,c,e & f

310. Vascular bundles of monocot stem lack
I) primary xylem II) phloem parenchyma
III) xylem parenchyma
IV) intrafascicular cambium
1) I & II 2) III & IV
3) II & IV 4) II & III

311. The anatomical parts/ tissues present in dicot stem but absent in monocot stem are
A) Medulla B) Pericycle
C) Phloem parenchyma
D) Medullary rays
E) Fascicular cambium
1) ABCD only 2) ACE only
3) ABCDE 4) ACD only

312. Vascular bundles of Dicot stem and monocot stem are differ in
A) Type B) Number
C) Location
D) Mode of xylem growth
1) A B C D 2) ABC only
3) BCD only 4) BC only

313. Arrange the following zones of roots from apex to base
A)Meristematic B)Maturation
C)Root cap D)Elongation
1)B,D,A,C 2)B,D,C,A
3)C,A,B,D 4)C,A,D,B

314. Parenchymatous tissue is the seat of
I) Photosynthesis
II) Storage of food materials
III) Secretion
1) I and II only 2) II and III only
3) I and III only 4)I, II, III

315. Findout the correct statement from the following
I) In all gymnosperms vessels are present.
II) Vessels are found in some pteridophytes
III) Sieve cells occur in the phloem of pteridophytes.
IV) The companion cell and the sieve tube element develop from the same mother cell.
1) I and II 2) II and III
3) III and IV 4) I and IV

316. Findout the incorrect statements from the following.
I) Intercalary meristems present in all angiosperms.
II) All lateral meristems are secondary meristems.
III) All secondary meristem are lateral in position.
IV) All meristematic cells are actively dividing cells.
1)I and IV 2)I and III 3)I and II 4)II and III

317. Findout the true statements
I) Collenchyma is a dead mechanical tissue.
II) Angular collenchyma is commonly present in dicots.
III) Parenchyma is a most primitive simple tissue.
IV) Sclerenchyma is a living mechanical tissue.
1) I and IV 2) II and III
3) III and IV 4) II and IV

318. Identify the incorrect statement from the following
I) Dicot stem show atactostele.
II) Polyarch xylem is present in the root of *Zea*.
III) Fibrovascular bundles are present in monocot stem.
IV) Protoxylem lacuna is a schizogenous cavity.
1) I and II 2) II and III
3) III and IV 4) I and IV

319. Findout correct statement
I) Primary xylem developed from vascular cambium.
II) Centrifugal xyelm is present in the stems of angiospermic plant.
III) Closed vascular bundles are present in leaves of dicots and monocots.
IV) Bicollateral vascular bundles are mainly present in the family cucurbitaceae.
1) I, II, III 2) II, III and IV
3) IV only 4) I and II

320. Findout incorrect statement
I) Heart wood is called alburnum.
II) Lenticels have epithelial cells
III) Multiple epidermis seen in leaves of Ficus.
IV) Calyptrogen forms root cap.
1) I, II and III 2) II and III
3) II, III and IV 4) I only

321. Findout correct statement from the following
I) Motor cells are present on adaxial epidermis of monocot leaves
II) Cambium is present only with fusiform initials.
III) Xylem is present in leaves towards adaxial epidermis.
IV) In Smilax root has many vascular bundles.
1) I and II 2) II and III
3) III and IV 4) IV only

322. Find out incorrect statements from the following
I) Sieve tube and companion cells are present only in gymnosperms.
II) Sieve cells and albuminous cells are present only in 1st and 2nd tracheophytes.
III) Sieve cells are absent in all angiosperms.
IV) Ray parenchyma is seen only in secondary xylem and secondary phloem.
1) I only 2) II and III
3) III and IV 4) I and IV

TYPE - III

323. Study the following Lists

List - I (EVENT)	List - II (RESULT)
I Differentiation	A. Cork cambium
II Dedifferentiation	B. Embryonic meristem
III Redifferentiation	C. Tracheary elements
IV Specialization	D. Secondary phloem
	E. Permanent cells

The correct match is

	I	II	III	IV		I	II	III	IV
1)	B	A	C	D	2)	E	A	D	C
3)	D	A	E	C	4)	E	A	C	D

324. Study the following table

Table - I [part]	**Table - II [position]**
I. Endodermis	A.Outer most layer of stele
II. Pericycle	B.Outer most layer of cortex
III.Hypodermis	C.Inner most layer of cortex
IV. Secondary phloem	D.Inner most layer of Bark
	E. Inner most layer of stele

The correct match is

	I	**II**	**III**	**IV**		**I**	**II**	**III**	**IV**
1)	A	C	B	D	2)	C	A	D	B
3)	A	B	C	D	4)	C	A	B	D

325. Match the following

I. Growth rings	A. Lianes
II. Growth marks	B. Sec- meristem
III. Pseudo - annual rings	C. Temparate tree
IV. Phellogen	D. Heavy leaf fall
	E. Tropical trees

The correct match is

	I	**II**	**III**	**IV**
1)	C	E	B	D
2)	C	E	D	B
3)	E	C	D	B
4)	C	D	E	B

326. Match the following lists

List - I	List - II
A. Trichomes	I. Cambium
B. Root hair	II. Leaves
C. Mesophyll	III. Unicellular
D. Dicotyledonous	IV. Epidermal hairs

The correct match is

	A	**B**	**C**	**D**
1)	III	IV	II	I
2)	IV	III	I	II
3)	IV	III	II	I
4)	I	II	III	IV

327. Match the following

Xylem element	**Shape/character**
A. Tracheid	I. Spindle shaped
B. Vessel member	II. Living element
C. Xylem fibre	III. Cylindrical
D. Xylem parenchyma	IV. Universal conducting elemnts

The **correct** combination is

	A	B	C	D
1)	I	III	IV	II
2)	IV	I	III	II
3)	I	IV	III	II
4)	IV	III	I	II

328. Match the following

A) Hypodermis of Dicotstem — I) Non-living, mechanical, simple tissue
B) Hypodermis of monocot stem — II) Living, non-mechanical, simple tissue
C) Pericycle of Dicotstem — III) Living, mechanical, simple tissue
D) Bundle sheath of monocot stem — IV) Non-living, mechanical, simple tissue
V) Living, mechanical, simple tissue
VI) Dead, mechanical, simple tissue

The correct match is

	A	B	C	D
1)	IV	I	V	V
2)	III	I	IV	II
3)	V	I	II	III
4)	III	IV	I	VI

329. Study the following lists

List-I	List-II
A) Parenchyma	I) Uniformly thickened cellwalls
B) Collenchyma	II) Stratified layers of lignin
C) Fibres	III) End walls absent
D) Sclereids	IV) Unevenly thickened cellwalls
	V) Primary pit fields

The correct match is

A	B	C	D		A	B	C	D
1) V	IV	I	II	2) V	III	I	II	
3) V	II	I	IV	4) IV	V	II	I	

330. Study the following lists

List-I	List-II
A) Apical meristems	I) Promotes vertical growth in grasses
B) Lateral meristems	II) Enhances cylindrical growth of stems and roots
C) Intercalary meristems	III) Primary meristems that can produce secondary meristems
D) Fascicular vascular cambium	IV) Derived from lateral meristems
	V) Primary meristems produces dermal, ground and vascular tissues

The correct match is

A	B	C	D		A	B	C	D
1) V	II	I	III	2) V	IV	I	III	
3) V	II	I	II	4) IV	III	II	V	

331. Study the following lists

List-I	List-II
A) Xylem	I) Component of epidermal tissue system
B) Cortex	II) Stelar part of dicot stem
C) Bulliformcells	III) Component of ground tissue system
D) Semilumar shaped sclernchy-matouspericycle	IV) Component of vascular tissue system
	V) Stelar part of monocot stem

The correct match is

A	B	C	D		A	B	C	D
1) III	II	I	IV	2) III	V	I	II	
3) IV	III	I	II	4) IV	V	I	II	

332. Study the following lists

List-I	List-II
A) Complimentary cells	I) Spring wood and Autumn wood
B) Heart wood	II) Lenticels
C) Sap wood	III) Non-functional secondary xylem
D) Annual ring	IV) Functional secondary xylem
	V) Periderm

The correct match is

	A	B	C	D
1)	II	III	IV	I
2)	II	III	V	I
3)	II	IV	V	III
4)	II	V	III	I

TYPE - IV

MULTIPLE MATCHING TYPE

333. Study the following table

Tissue	Produced by	Function
I) Phellogen	Cortical tissue	Produces phellum and phelloderm
II) Intrafascicular cambium	Undifferentiated procambium	One of the forerunner tissue of secondary xylem and secondary phloem
III) Heart wood	Non-functional modified secondary xylem	Provides mechanical support
IV) Interfascicular cambium	Medullary parenchyma	Promotes cylindrical growth of the stems and roots

The correct combinations are

1) I & II 2) II & III 3) III & IV 4) I, II, III & IV

334. Study the following table

Tissue	**Produced from body**	**Site of occurrence in the plant**
I) Companion cells	Parenchyma	Phloem
II) Primary xylem & primary phloem	Procambium	Embryonic tissue
III) Sclereids	Modified simple tissue	Pericarp
IV) Calyptrogen	Dermal tissue	Root apex

The correct combinations are

1) I & IV 2) II & III 3) I & III 4) I, II, III & IV

335. Study the following table

Type of Vascular bundle found in stems, roots & leaves	**Occurence**	**Orientation of xylem and phloem elements**
I) Collateral and open type	Dicot stem	Exarch xylem and endarch phloem
II) Collateral and closed	Monocot stem	Endarch and enclosed by bundle sheath
III) Collateral and closed	Leaves	Exarch or endarch
IV) Radial, seperated	Roots	Exarch

The correct combinations is

1) I & III 2) I & II 3) II & IV 4) I, II, III & IV

336.

List-I	List - II	List - III
A) Meristem	P) Many vacuoles	V) Lignified cell wall
B) Parenchyma	Q) Living mechanical tissue	X) Tensile strength
C) Collenchyma	R) Fundamental tissue	Y) Primitive tissue
D) Sclerenchyma	S) Dead tissue	Z) Proplastids

1) A-R,Z, B-P,Y, C-Q,X, D-S,V
2) A-P,Z, B-R,X, C-Q,Y, D-S,V
3) A-P,Z, B-R,Y, C-Q,X, D-S,V
4) A-P,Y, B-R,Z, C-Q,X, D-S,V

337.

List-I	List - II	List - III
I) Xylem	A) Mechanical strength	P) Shoot apex
II) Phloem	B) Food conduction	Q) Hypodermis of dicot stem
III) Collenchyma	C) Growth	R) Tracheids
IV) Meristem	D) Water conduction	S) Sieve cells

1) I-D,P, II-B,S, III-A,Q, IV-C,R
2) I-D,R, II-B,S, III-A,Q, IV-C,P
3) I-C,P, II-B,S, III-A,Q, IV-D,R
4) I-D,R, II-B,Q, III-A,S, IV-C,P

338.

List-I	List - II	List - III
I) Apical meristem	A) Root tip	P) Extrastelar secondary growth
II) Intercalary meristem	B) Inner cortex	Q) Intrastelar secondary growth
III) Cork cambium	C) Stele	R) Linear growth of stems and leaves
IV) Vascular cambium	D) Base of internodes & leaves of grasses	S) Primary meristem

1) I-A,S, II-D,R, III-B,P, IV-C,A
2) I-A,R, II-D,S, III-B,Q, IV-C,P
3) I-A,S, II-D,P, III-B,R, IV-C,Q
4) I-A,R, II-D,Q, III-B,P, IV-C,S

339.

List-I	List - II	List - III
I) Primary xylem	A) Axile and ray parenchyma	P) Procambium
II) Primary phloem	B) Axial parenchyma	Q) Vascular cambium
III) Secondary xylem	C) Axial parenchyma	R) Vascular cambium
IV) Secondary phloem	D) Axial and ray parenchyma	S) Procambium

1) I-B,Q, II-C,S, III-A,P, IV-D,R
2) I-B,P, II-C,S, III-A,Q, IV-D,R
3) I-B,S, II-C,P, III-A,Q, IV-D,R
4) I-B,P, II-C,Q, III-A,S, IV-D,R

340.

List-I	List - II	List - III
I) Dicot root	A) Absence of endodermis	P) Protoxylem
II) Dicot stem	B) Tetrach xylem	Q) Sclerenchyma medulla
III) Monocot root	C) Polyarch xylem	R) Reduced pith
IV) Monocot stem	D) Eustele	S) Medullary rays

1) I-B,R, II-D,S, III-C,Q, IV-A,P
2) I-B,R, II-D,S, III-C,P, IV-A,Q
3) I-B,S, II-D,R, III-C,Q, IV-A,P
4) I-D,R, II-B,S, III-A,P, IV-C.Q

TYPE - V

341. The chief water conducting elements of xylem in gymnosperms are **[CBSE AIPMT 2010]**
1) vessels 2) fibres
3) transfusion tissues 4) tracheids

342. The annular and spirally thickened conducting elements generally develop in the protoxylem when the root or stem is **[CBSE AIPMT 2009]**
1) maturing 2) elongating
3) widening 4) differentiating

343. In barley stem, vascular bundles are **[CBSE AIPMT 2009]**
1) open and scattered 2) closed and scattered
3) open and in a ring 4) closed and radial

344. Palisade parenchyma is absent in leaves of **[CBSE AIPMT 2009]**
1) *Sorghum* 2) Mustard
3) Soybean 4) Gram

345. Anatomically fairly old dicotyledonous root is distinguished from the dicotyledonous stem by **[CBSE AIPMT 2009]**
1) absence of secondary xylem
2) absence of secondary phloem
3) presence of cortex
4) position of protoxylem

346. The length of different internodes in a culm of sugarcane is variable because of **[CBSE AIPMT 2008]**
1) shoot apical meristem
2) position of axillary buds
3) size of leaf lamina at the node below each internode
4) intercalary meristem

347. For a critical study of secondary growth in plants, which one of the following pairs is suitable? **[CBSE AIPMT 2007]**
1) Sugarcane and sunflower
2) Teak and pine
3) Deodar and fern
4) Wheat and maiden hair fern

348. A common structural feature of vessel elements and sieve tube elements is **[CBSE AIPMT 2006]**
1) thick secondary walls
2) pores on lateral walls only
3) presence of perforated end walls
4) Binucleate condition

349. In the sieve elements, which one of the following is the most likely function of P-proteins? **[AIIMS 2006]**
1) Deposition of callose on sieve plates
2) Providing energy for active translocation
3) Autolytic enzymes
4) Sealing mechanism on wounding

350. Vessels differ from tracheids **[AFMC 2005]**
1) In being living
2) In being derived from a single cell
3) In having vertical row of cells with cross walls dissolved
4) Because they conduct water

351. Companion cells in plants are associated with **[AIIMS 20407]**
1) vessels 2) sperms
3) sieve elements 4) guard cells

352. In a woody dicotyledonous tree, which of the following parts will mainly consist of primary tissues? **[CBSE AIPMT 2004]**
1) Stem and root 2) All parts
3) Shoot tips and root tips
4) Flowers, fruits and leaves

353. The apical meristem of the root is present **[CBSE AIPMT 2003]**
1) only in adventitious roots
2) in all the roots 3) only in radicals
4) only in tap roots

354. In which of the following organs, growth is sub-apical? **[AIIMS 2003]**
1) Root 2) Shoot
3) Petiole 4) Pedicel

355. In a dicotyledonous stem, the sequence of tissues from the outside to the inside is **[AIIMS 2003]**
1) phellem – pericycle – endodermis – phloem
2) phellem – phloem – endodermis – pericycle
3) phellem – endodermis – pericycle – phloem
4) pericycle – phellem – endodermis – phloem

356. Gritti flesh of guava is due to the presence of : **(AMU 2000)**
1) Fibres 2) Sclereids
3) Crystals 4) Seeds

357. Vascularization in plant means : **(CBSE 2000)**
1) Formation of procambium followwed by formation of primary vascular bundles
2) Formation of proambium followed by formation of cambium
3) formation of cambium followed by formation of procambium
4) All of the above

358. Cork cambium and vascular cambium are the examples of
1) Apical meristem 2) Lateral meristem
3) Wound meristem 4) Intercalary meristem

359. The healing of wound in plants takes place by the activities of : **(CBSE 2000)**
1) Apical mristem 2) Lateral meristem
3) Secondary meristem 4) Intercalary meristem

360. Inulin and raphide crystals are which type of plant products ? **(CBSE 2001)**
1) Excretory 2) Inorganic
3) Respiatory 4) Ergastic

361. Which of the following is a living mechanical tissue? **(Manipal 2001, 04)**
1) Parenchyma 2) Collenchyma
3) Sclerenchyma 4) Chlorenchyma

362. Cork cambium is a **(JKCMEE2002)**
1) Apical meristem 2) Promeristem
3) Lateral meristem 4) Intercalary meristem

363. Vessels and fibres are found in xylem of
1) Angiosperms 2) Gymnosperms
3) Pteridophytes 4) All vascular plants

364. Secondary xylem is : **(JKCMEE2002)**
1) Wood 2) Bark 3) Cork 4) Bast

365. Cotton is **(DPMT 2001)**
1) Epidermal tissue sap system
2) Vascular tissue system
3) Meristem tissue 4) Ground tissue system

366. Sieve tube differs from sieve cells because they have **(DPMT 2001)**
1) Sieve pores at end wall 2) Nucleus
3) No Cytoplasm 4) None of these

367. Procambium forms : **(DPMT 2001)**
1) Cork cambium 2) Vascular cambium
3) Vascular tissue 4) Ground tissue

368. Grafting is not possible in monocots because the vascular bundles are **:** **(RPMT 2001)**
1) Scattered 2) Closed
3) Open 4) With bundle sheath

369. Companion cells are associated with: **(RPMT 2001)**
1) tracheids 2) Vessels
3) Sieve tubes of angiosperms
4) Sieve tubes of gymnosperms

370. The scutellum of maize or wheat seed represents: **(AIPMT 2010)**
1) Cotyledon 2) Endosperm
3) Aleuron layer 4) Plumule

371. In which living cell of vascular tissue, healthy nucleus and cytoplasm are found ? **(RPMT 2001)**
1) Sieve tubes 2) Xylem tracheids
3) Xylem vessels 4) Medullary rays

372. Vascular bundle in which phloem is found on both sides of xylem is : **(RPMT 2001)**
1) Collateral type 2) Bicollateral type
3) Concentric type 4) Radial type

373. Annual rings are most clear in : **(RPMT 2000)**
1) Tropical region 2) Temperate region
3) Xerophytes 4) Hydrophytes

374. In dorsiventral leaves, phloem is situated towards: **(RPMT 2000)**
1) Abaxial side 2) Adaxial side
3) Both the sides 4) Lateral side

375. Leaves having stomata on both the surfaces are called : **(RPMT 2000)**
1) Epistomatic 2) Hypostomatic
3) Amphistomatic 4) Astomatic

376. Grasses fold their leaves due to formation of **(AMU 2006; JCECE)**
1) Bulliform cells 2) Stomata
3) Hydathodes 4) Transfusion tissue

377. Bast fibre is obtained from : **(RPMT 2000)**
1) Xylem 2) Phloem
3) Pericycle 4) Epidermis

378. Tracheids differ from vessel in having: **(RPMT 2000)**
1) Thicker cell wall 2) Bordered pits
3) More length 4) None of these

379. Maximum growth occurs during **(RPMT 2000)**
1) Spring season 2) Autumn season
3) Summer season 4) Winter season

380. Tissue responsible for origin of lateral roots : **(RPMT 2000)**
1) Cortex 2) Endodermis
3) Pericycle 4) Vascular tissue

381. Wood is the common name of **(MPPMT 2004)**
1) Phloem 2) Vascular cambium
3) Cambium 4) Secondary xylem

382. Vascular cambium never develops in stem of **(AMU 2001)**
1) Banana 2) Mango
3) Guava 4) Sunflower

383. Porous wood contains mainly: **(AIIMS 2001)**
1) Tracheids 2) Vessels
3) Fibres 4) parenchyma

384. Vascular cambium of root is an example of **(AIIMS 2001)**
1) Apical meristem 2) Primary meristem
3) Secondary meristem 4) Root apices

385. Generally a monocot stem bears : **(BHU 2002)**
1) Bicollateral and closed V.B.
2) Collateral and closed V.B
3) Bicollateral and open V.B
4) Collateral and open V.B

386. Epidermis and epiblema are produced by : **(BHU 2002)**
1) Phellogen 2) Protoderm
3) Procambium 4) Calyptrogen

387. Which of the following is an anucleated living cell at maturity ? **(BHU 2002)**
1) Vessels 2) Tracheids
3) Sieve tube 4) All of these

388. Raphids are found in : **(BHU 2002)**
1) *Pistia* 2) *Acacia*
3) *Asparagus* 4) *Dahlia*

389. Tyloses are : **(BHU 2000)**
1) Compound sieve tubes 2) Laticiferous vessels
3) Specialized secretory cells
4) Tracheal plugs which plug the lumen of xylem vesselss

390. Functional xylem in a dicot tree is : **(AFMC 2001)**
1) Sap wood 2) Heart wood
3) Hard wood 4) Autumn wood

391. Which of the following cells is totipotent ? **(AFMC 2001)**
1) Meristem 2) Sieve tube
3) Collenchyma 4) Xylem vessels

392. Cutin is secreted by **(CPMT 2002)**
1) Periderm 2) Hypodermis
3) Epidermis 4) Periderm and hypodermis

393. Quiescent centre is found near : **(CPMT 2002)**
1) stem 2) Leaf
3) Root apex 4) Shoot apex

394. Amphivasal vascular bundles are also called: **(CPMT 2002)**
1) Hydrocentric 2) Leptocentric
3) Hedrocentric 4) None of these

395. Periderm includes : **(CPMT 2002)**
1) Cork and cork cambium
2) Cork and secondary cortex
3) Cork cambium and secondary cortex
4) Cork, cork cambium and secondary cortex

396. Lightest wood is produced by : **(JIPMER 2002)**
1) *Hardwickia binata* 2) *Ochroa longopus*
3) *Cereus giganteus* 4) *Cycas*

397. Cells of parenchyma are characterized by presence of **(JIPMER 2002)**
1) Uniform thickness 2) More thick corners
3) Lignification 4) Suberization

398. Fibres are obtained from **(JIPMER 2002)**
1) Xylem, phloem and sclerenchyma
2) Xylem and sclerenchyma
3) Only sclerenchyma
4) Only stone cells

399. Starch is mainly manufactured by: **(JIPMER 2002)**
1) Palisade mesophylls 2) Spongy mesophylls
3) Guard cells 4) Epidermal cells

400. In a vascular bundle, if protoxylem is towards ericycle and metaxylem towards the centre, the condition is referred to as : **(Har. PMT 2000)**
1) Open 2) Closed
3) Endarch 4) Exarch

401. In which of the following, the vascular bundles are found arranged in a ring ? **(Har. PMT 2000)**
1) Monocot stem 2) Dicot stem
3) Leaves 4) Roots

402. Four radial vascular bundles are found in : **(Har. PMT 2000)**
1) Roots of dicots 2) Roots of monocots
3) stem of dicots 4) Dracaena stem

403. Vessels are found in : **(Har. PMT 2000)**
1) All angiosperms and some gymnosperms
2) Most of the angiosperms and a few gymnosperms
3) All gymnospers and all angiosperms
4) Only in angiosperms

404. The histogen forming root cap is : **(AIIMS 2000)**
1) Dermatogen 2) Pleurome
3) Calyptrogen 4) Periblem

405. which of the following lack collenchyma ? **(CPMT 2000)**
1) Dicots 2) Monocots
3) Cucurbits 4) All of these

406. A scientist who wish to study virus free plant part of a virus infected plant should observe: **(AIIMS 2000)**
1) Shoot apex 2) Root apex
3) Leaves 4) Cortex

407. The limiting layer of stele is : **(Manipal 2004)**
1) Epidermis 2) Endodermis
3) Piliferous layer 4) Epiblema

408. Lateral meristem is responsible for : **(MPPMT 2004)**
1) Growth in length 2) Growth in thickness
3) Growth in parenchyma 4) Growth in cortex

409. Vascular bundles where the phloem is found to be present on both the sides of xylem is said to be **(Kerala PMT 2004)**
1) Radial 2) Conjoint
3) Collateral 4) Bicollateral

410. Intercalary meristem results in : **(Kerala PMT 2004)**
1) Secondary growth 2) Primary growth
3) Apical growth 4) None of these

411. Leptome is used for : **(BHU 2006)**
1) Phloem 2) Xylem
3) Fibres 4) Parenchyma

412. Which one of the following statement is correct, for "bundle sheath of monocot leaves is similar to that of monocot stem", as both of them ? **(EAMCET 2006)**
1) Possess outer layer of chlorenchyma and inner layer of thick - walled cells without chloroplasts
2) Possess extensions made up of sclerenchyma
3) Resemble the endodermis in possession of casparian strips
4) Encircle the vascular bundles, which are conjoint and collateral

413. Polyarch condition is found in : **(CPMT 2007)**
1) Monocot roots 2) Dicot roots
3) Monocot stem 4) Dicot stem

414. Endodermis mainly helps in : **(CPMT 2007)**
1) Preventing loss of water from stele
2) Providing protection
3) Maintaining rigidity 4) All of the above

415. Collenchyma is : **(CPMT 2007)**
1) Living and contains protoplasm
2) Dead and hollow
3) Dead and filled with food reserves
4) Living and contains no food reserves

416. Passage cells are thin - walled cells found in **(AIPMT 2007)**

1) Phloem elements that serve as entry point for substances for transport to other plant parts

2) Testa of seeds to enable emergence of growing embryonal axis during seed germination

3) Central region of style through which the pollen tube grows towards the ovary

4) Endodermis of roots facilitating rapid transport of water from cortex to protoxylem through pericycle

417. Biologically most resistant plant material is **(Uttarakhand PMT 2007)**

1) Lignin 2) Cutin

3) Suberin 4) Sporopollenin

418. Tyloses thickening are seen in : **(BHU2008; Manipal 2008)**

1) Collenchyma 2) Phloem

3) Ray parenchyma

4) Ray parenchyma and xylem vessels

419. The waxy material deposited in the casparian strips of endodermis is : **(CMC, Vellore 2008; Kerala PMT 2008)**

1) Pectin 2) Suberin

3) Cellulose 4) Lignin

420. Closed vascular bundles are characterized by : **(Orissa JEE 2008)**

1) Presence of cambium 2) Absence of cambium

3) Both 1 and 2 4) None of these

421. The meristem responsible for extra - stelar secondary growth in dicot stem is : **(CMC, Vellore 2008)**

1) Interfascicular cambium

2) Intrafascicular cambium

3) Intercalary meristem 4) Phellem

422. In an annual ring, the light coloured part is known as **(DPMT 2009)**

1) Early wood 2) Late wood

3) Heart wood 4) Sap wood

423. Which of the following is true ? **(DPMT 2009)**

1) Vessels are unicellular and with narrow lumen

2) Vessels are multicellular and with wide lumen

3) Tracheids are unicellular and with wide lumen

4) Tracheids are multicellular and with narrow lumen

424. Alburnum is otherwise known as : **(Kerala PMT 2009)**

1) Periderm 2) Sap wood

3) Heart wood 4) Bark

425. At maturity, the sieve plates become impregnated with : **(Kerala PMT 2009)**

1) Cellulose 2) Pectin

3) Suberin 4) Callose

426. Anatomically, fairly old dicot root is distinguished from dicot stem by **(AIPMT 2009)**

1) Position of protoxylem

2) Absence of secondary xylem

3) Absence of secondary pholem

4) Presence of cortex

427. Match the following and choose the correct combination : **(KeralaPMT 2009)**

A) Endodermis	1) Companion cells
B) Stomata	2) Lenticels
C) Sieve tube	3) Palisade cells
D) Periderm	4) Passage cells
E) Mesophyll	5) Accessory cells

1) A = 4, B = 5, C = 2, D = 1, E = 3

2) A = 5, B = 3, C = 1, D = 2, E = 4

3) A = 4, B = 5, C = 1, D = 2, E = 3

4) A = 2, B = 5, C = 3, D = 4, E = 1

428. In dicot roots, initiation f lateral roots take place in : **(Kerala PMT 2011)**

1) Epidermal cells 2) Cortical cells
3) Endodermal cells 4) Pericycle

429. In some xerophytic grasses, certain adaxial epidermal cells along the veins modify themselves in to large, empty, olourless cells called: **(Kerala PMT 2011)**

1) Bulliform cells 2)Companion cells
3) Guard cells 4) Subsidiary cells

1) Position of protoxylem
2) Absence of secondary xylem
3) Absence of secondary pholem
4) Presence of cortex

430. Vascular bundles in monocotyledons are considered closed because **[Neet - 2015]**

1) there are no vessels with perforations
2) xylem is surrounded all around by phloem
3) a bundle sheath surrounds each bundle
4) cambium is absent

431. A major characteristic of monocot root is the presence of **[Neet - 2015]**

1) vasculature without cambium
2) cambium sandwiched betweeen phloem and xylem along the radium
3) open vascular bundles
4) scattered vascular bundles

432. Read the different components from (i) to (iv) in the list given below and tell the correct order of the components with reference to their arrangement from outer side to inner side in a woody dicot stem **[Neet - 2015]**

i) secondary cortex ii) wood
iii) secondary phloem iv) phellem

The coorect order is

1) iv, i, iii, ii 2) iv, iii, i, ii
3) iii, iv, ii, i 4) i, ii, iv, iii

433. Specialised epidermal cells surrounding the guard cells are called **[Neet - 2016]**

1) bulliform cells 2) lenticels
3) complementary cells 4) subsidiary cells

434. The balloon-shaped structures called tyloses **[Neet - II - 2016]**

1) oridinate in the lumen of vessels
2) characterise the sapwood
3) are extensions of xylem parenchyma cells into vessels
4) are linked to the ascent of sap through xylem vessels

435. Cortex is the region found between **[Neet - II - 2016]**

1) epiderm is and stele
2) pericycle and endodermis
3) endodermis and pith
4) endodermis and vascular bundle

436. Identify the wrong statement in context of heartwood **[Neet - 2017]**

1) it is higly durable
2) it conducts water and minerals efficiently
3) it conprises dead elements with highly lignified walls
4) organic compounds are deposited in it

437. Which of the following is made up of dead cells **[Neet - 2017]**

1) collenchyma 3) phellem
3) phloem 4) xylem parenchyma

438. Root hair develop from the region of **[Neet - 2017]**

1) elongation 2) root cap
3) meristematic activity
4) maturation

439. The vascular cambium normally gives rise to **[Neet - 2017]**

1) primary phloem 2) secondary xylem
3) periderm 4) phelloderm

440. Plants having little or no secondary growth are **[Neet - 2018]**

1) grasses 2) deciduous angiosperms
3) conifers 4) cycads

441. Casparian strips occur in **[Neet - 2018]**

1) epidermis 2) pericycle
3) cortex 4) endodermis

442. Secondary xylem and phloem in dicot stem are produced by **[Neet - 2018]**

1) apical meristems 2) vascular cambium
3) phellogen 4) axillary meristems

443. Stomata in grass leaf are **[Neet - 2018]**

1) dumb-bell shaped 2) kidney-shaped
3) rectangular 4) barrel-shaped

444. Phloem in gymnosperms lacks **[Neet-2019]**

1) both sieve tubes and companion cells
2) albuminous cells and sieve cells
3) sieve tubes only 4) companion cells only

445. Grass leaves curl inwards during very dry weather. Select the most appropriate reason from the following **[Neet-2019]**

1) Tyloses in vessels
2) closure of stomata
3) flaccidity of bulliform cells
4) shrinkage of air spaces in spongy mesophyll

446. Which of the statements given below is not true about formation of annual riongs in trees **[Neet-2019]**

1) annula rings are not prominent in tres of temperate region
2) annual ring is a combination of spring wood and autumn wood produced in a year
3) differential activity of cambium causes light and dark bands of tissue-early and late wood respectively
4) activity of cambium depends upon variation in climate

447. Regeneration of damaged growing grass following grazing is largely due to **[Odisha Neet - 2019]**

1) lateral meristem 2) apical meristem
3) intercalary meristem 4) secondary meristem

448. In the dicot root the vascular cambium originates from **[Odisha Neet - 2019]**

1) tissue located below the phloem bundles and a portion of pericycle tissue above protoxylem
2) cortical region
3) parenchyma between endodermis and pericycle
4) intrafascicular and interfascicular tissue in a ring

KEY

MODEL TEST - I

1)2	2) 3	3) 4	4) 1	5) 1
6) 2	7) 3	8) 4	9) 1	10) 2
11) 4	12) 4			

MODEL TEST - II

13) 3	14) 4	15) 2	16) 4	17) 2
18) 4	19) 1	20) 1	21) 1	22) 2
23) 2				

MODEL TEST - III

24) 3	25) 2	26) 3	27) 3	28) 1
29) 3	30) 2	31) 4	32) 1	33) 2
34) 3	35) 3			

MODEL TEST - IV

36) 2	37) 3	38) 2	39) 1	40) 2
41) 3	42) 2	43) 3	44) 2	45) 1
46) 1	47) 2	48) 1	49) 4	50) 1

MODEL TEST - V

51) 1	52) 4	53) 2	54) 3	55) 4
56) 1	57) 2	58) 4	59) 1	60) 3

QUESTION BANK

TEST - I

61) 4 62) 2 63) 1 64) 2 65) 2
66) 1 67) 1 68) 3 69) 3 70) 1
71) 4 72) 1 73) 3 74) 1 75) 4
76) 1 77) 4 78) 3 79) 1 80) 2
81) 4 82) 2 83) 2 84) 2 85) 2
86) 4 87) 2 88) 2 89) 2 90) 2
91) 4 92) 4 93) 4 94) 1 95) 2
96) 4 97) 2 98) 2 99) 4 100) 4
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106) 4 107) 2 108)3 109) 2 110) 3
111) 2 112) 3 113) 2 114) 1 115) 4
116) 1 117) 2 118)1 119) 3 120) 2
121) 2 122) 1 123) 2 124) 1 125) 1
126) 3 127) 2 128)4 129) 4 130) 4
131) 3 132) 1 133) 2 134) 1 135) 2
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146) 4 147)3 148)1 149) 1 150) 4
151) 4 152) 3 153) 3 154) 4 155) 4
156) 1 157) 1 158)2 159) 1 160) 1
161) 4 162) 1 163) 4 164) 2 165) 2
166) 3 167) 4 168) 4 169) 2 170) 2
171) 4 172) 1 173) 4 174)3 175) 2
176)3 177)4 178) 2 179) 1 180) 3
181) 2 182) 1 183) 1 184) 2 185)2
186)3 187) 3 188) 2 189)4 190) 3
191) 2 192) 2 193) 2 194) 4 195) 4
196)2 197) 2 198) 1 199) 2 200)3
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211) 4 212) 3 213) 4 214) 2 215) 4
216)3 217) 2 218) 2 219)4 220) 2
221) 1 222) 3 223)4 224) 1 225)1
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236) 2 237) 2 238)2 239) 2 240) 3
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251) 2 252) 3 253) 3 254) 1 255) 3
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266) 4 267) 1 268) 1 269) 2 270) 2
271) 3 272) 2 273) 2 274) 1 275) 4
276) 2 277) 2 278) 3 279) 4 280) 4
281) 3 282) 4 283) 2 284) 3

TEST - II

285) 3 286) 3 287) 4 288) 4 289) 4
290) 3 291) 1 292) 3 293) 1 294) 3
295) 4 296)4 297) 2 298) 3 299)3
300) 3 301) 1 302) 2 303) 3 304)3
305) 3 306) 2 307) 2 308)3 309)3
310) 3 311) 3 312) 2 313)4 314)4
315)2 316) 3 317) 2 318) 4 319) 2
320) 1 321) 4 322) 1

TEST - III

323) 2 324) 4 325) 2 326) 3 327) 4
328) 4 329) 1 330) 1 331) 3 332) 1

TEST - IV

333) 4 334)4 335) 3 336) 3 337) 2
338) 1 339) 2 340) 1

TEST - V

341) 4 342) 1 343) 2 344) 1 345) 4
346) 2 347) 2 348) 3 349)4 350) 3
351) 3 352)3 353)3 354) 2 355)3
356) 2 357) 1 358)2 359) 3 360) 4
361) 2 362) 3 363) 1 364) 1 365) 1
366) 1 367) 1 368) 2 369) 3 370) 1
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386) 2 387) 3 388) 1 389) 4 390) 1
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416) 4 417) 4 418) 4 419) 2 420) 2
421) 3 422) 1 423) 2 424) 2 425) 4
426) 1 427) 3 428) 4 429) 1 430) 4
431) 1 432) 1 433) 4 434) 3 435)1
436) 2 437) 2 438) 4 439) 2 440) 1
441) 4 442) 2 443) 1 444) 1 445) 3
446) 1 447) 3 448) 1

CH-13 : ECOLOGICAL ADAPTATION SUCCESION AND ECOLOGICAL SERVICES

INTRODUCTION

SYNOPSIS

* Ecology is an inter discplinary branch of biology
* Ecology deals with the study of distribution and various aspects of life of organisims and their interaction witht he environement.
* Ecology is broadly divided into plant ecology and animal ecology.
* The term 'Ecology' was coined by Reiter.
* The term Ecology was derived from Greek word Oekologie. (Oikos = home, logos = study)
* Ecology is generally defined as the study of plants. and animals reciprocal relationship with their environement.
* Warming defined ecology as the study of organisms in relation to their environment.
* Warming actually employed this science to plants.
* E.P Odum defined ecology as the structure and function of nature.
* Different levels of organisation in ecology include protoplasm, cells, tissues, organs, organisims, population, community, ecosystem and biosphere
* A group of similar individuals belonging to the same species found in an area are together called population.
* An assemblage of all populations of different species occuring in an area is called comunity
* The interation between the biotic (living organisims) and abiotic (physical environment) components is called ecosystem.
* The term 'Ecosystem'was coined by A.G Tansley
* The structural and functional unit of nature is Ecosystem
* The biologically inhabitated part of the earth consisting of all ecosystem of the world is called biosphere or ecosystem
* The earth is considered as a 'Giant Ecosystem'.

➢ **Ramdeo Misra** is known as the **father of ecology in India**

➢ **R.Misra** worked on tropical communities, Succession, nutrient cycling, Grassland ecosystem etc.

➢ **Plant Ecology** is a branch of botany which deals with the study of plants in relation to their environment.

➢ Ecology is basically concerned with four levels of biological organisation **- organisms, populations, communities and biomes.**

➢ Formation of different types of biomes is mainly attributable to variations in seasons and precipitation.

➢ Desert, Rain forest, tundra, Sea coast deciduous forest are the major types of biomes on the earth.

➢ Adaptations allow the organism to survive and reproduce in its habitat.

➢ ***Opuntia*** is a succulent xerophyte that stores water in the form of mucilage.

➢ Adaptations are genetically fixed and are products of long evolutionary process.

➢ **Crassulacean Acid metabolism (CAM)** is a speciality of *cacti* that enables them to survive in desert conditions.

➢ Important adaptations in xerophytes are thick cuticle, sunken stomata, spines/ scale leaves, phyllocaldes and phyllodes.

➢ Halophytes can tolerate the salinities of the sea. Ex: *Rhizophora.*

PLANT COMMUNITIES :

Adaptation is any attribute of the organism (Morphological, physiological, behavioural) that enables the organism to survive and reproduce in its habitat.

➢ Plants growing in desert areas –**Xerophytes**

➢ Plants growing in salinities of the sea – **Halophytes**

➢ Plants growing in direct sunlight **–Heliophytes**

➢ Plants growing in shady places–**Sciophytes**

➢ **Eugen warming** classified plant communities on the basis of the dependence and relation of plants to water into three ecological groups .

1. Hydrophytes 2.Xerophytes 3. mesophytes.

HYDROPHYTES :

Plants that grow in water or in very wet places are hydrophytes. they are further subdivided into five categories.

1. **Free floating hydrophytes** : They have no contact with soil and float freely on water surface Eg :-*Pistia, Lemna, Salvinia.*

2. **Rooted hydrophytes with floating leaves:-** Roots are fixed to substratum (mud) but their long petiolated leaves keep them floating on water surface Eg:-*Nymphaea* and *Victoria regia.*
3. **Submerged suspended hydrophytes :** They have contact only with water, not rooted in mud
   Eg:- *Hydrilla* and *Utricularia*
4. **Submerged rooted hydrophytes :-** They are completely submerged in water and rooted
   Eg:- *Vallisneria*
5. ***Amphibious Plants*** :- plant body is partly in water and partly in air
   Eg:- *Sagittaria, Typha* and *Limnophila*

Ecological adaptations of hydrophytes:

Morphological and Anatomical characteristics are mostly common to all hydrophytes but may differ only in some.

MORPHOLOGICAL ADAPTATIONS:-

Roots:-

Due to surplus of water in the habitat, roots are of secondary importance and less significant. It is very poor in most of the hydrophytes.

a) **Root system is absent in** *Wolffia*, *Ceratophyllym* and poorly developed in *Hydrilla*.
b) Roots, if present are generally fibrous, adventitious, reduced in length, unbranched or poorly branched.
c) **Root caps are usually absent**. Root pockets replace root caps in *Pistia*.
d) Well developed root system serving as balancing roots are found in *Pistia, Eichhornia* etc. In this system root hairs are reduced or absent.
e) In plants like *Victoria, Nymphaea, Nelumbium* etc., roots are well developed with root caps. Roots of these plants are fixed to the soil (mud) but their long petiolated leaves float on water surface

Stem:-

a) Stem is long, slender, flexible and transparent.
b) In *Nymphaea Nelumbium* etc.,the stem is rhizomatous.

Leaves:-

a) Leaves are thin, delicate, ribbon like in *Vallisneria.* or Long and linear
b) Much dissected leaves in *Ceratophyullum*, *Utricularia.*
c) Floating leaves are large and flat with their upper surfaces coated with wax
   Eg:- *Nymphaea, Nellumbium, Victoria.*
d) Swollen, spongy petioles, which gives buoyancy to the plant found in free floating plants
e) The largest simple leaves in the form of plates are found in *Victoria regia*
f) Heterophyllous plants with two or more kinds of leaves are found in *some hydrophytes* with submerged floating and aerial leaves.

Anatomical adaptations:-

a) **Cuticle** is totally absent in submerged parts of plant. It may be present exposed part as very fine film.
b) **Epidermis** is composed of thin walled cells containing chloroplasts, Cutin is absent .
c) **Stomata** are totally absent in submerged hydrophytes as gas exchange takes place directly through thin cell walls by **diffusion.** In floating leaves the leaves are epistomatous.
d) All hydrophytes contain **Aerenchyma** that helps in gaseous exchange and buoyancy. Mechanical tissues and xylem are poorly developed.

MESOPHYTES:-

- Mesophytes are plants that normally grow in habitats where water is neither scarce nor abundant.
- In such habitats the pore space in soil is occupied almost equally by water and soil atmosphere.
- Such a balanced condition of water and gases is very suitable for plant growth.
- Mesophytes are very extensive on the surface of land and most crops like eg.:- Wheat, Maize, Barley, Pea, Sugarcane , Species in grass lands, tropical and temperate forests are all mesophytes.

XEROPHYTES :

Xerophytes are characteristic of desert and semi-desert regions but can grow in mesophytic conditions also.

Plants growing in soils deficient of water and appear physically dry are called **physical xerophytes.**

Eg: *Casuarina, Bryophyllum, Euphorbia*

Plants growing in soils having water and appear physically wet but not in a condition to be absorbed are called physiological xerophytes.

Eg: *Mangrooves*

Based on the degree of resistance to drought xerophytes are of three types

1. Ephemerals 2. Succulent 3. Non-Succulent

1. **Ephemerals (Drought escapers) :** These are annuals, mostly found in arid (dry) zones and complete their life cycle within very short period eg. *Tribulus*.
2. **Succulents (Drought avoiding plants)** : These absorb large quantities of water during rainy season and store it in different plant parts usually in the form of mucilage becoming fleshy or succulent in parts like the stem-*Opuntia*, leaf-*Aloe, Agave, Bryophyllum,* Root-*Asparagus*
3. **Non-Succulents (True xerophytes) :** These are perennial plants which are true xerophytes and can with stand prolonged period of drought
   Eg : *Casuarina, Zizyphus, Calotropis, Nerium*

ECOLOGICAL ADAPTATIONS IN XEROPHYTES :

All the three Ephemerals, succulents, non-succulent may differ in several ways but share certain common features.

Roots:

a) Extensively branched deep seated and wide spread root system is found in xerophytes
b) Root caps and root hairs are well developed.

Stem :

a) Stems are stunted, woody, hard, reduced in size and covered by thick bark.
b) Stems are modified into phylloclades
   Eg: *Opuntia, Cactus, Casuarina, Euphorbia* and into cladodes Eg: *Asparagus, Ruscus.*
c) In Succulent Xerophytes stem store water as mucilage in water storage tissue
   Eg: *Opuntia, Cactus*

Leaves :

a) Extent of reduction of leaves in xerophytes depends on the degree of xerophytism.
b) Leaves are reduced to spines & Scale leaves in Eg.:- *Opuntia, Cactus, Euphorbia sps, Asparagus, Casuarina*.
c) Thick, fleshy succulent leaves are found in
   Eg: *Bryophyllum, Aloe, Agave etc.,*

ANATOMICAL ADAPTATIONS :

a) Epidermis is covered with thick cuticle and is multilayered *(Nerium)*.
b) Epidermal cells may have silica crystals
c) Stomata are confined to lower epidermis (Hypostomatous) present in sunken pits (sunken stomata)
d) Mechanical and vascular tissues are relatively well developed.
e) Xerophytes show well developed cutinized and lignified tissues. Cuticle is very thick to reduce transpiration.
f) Xerophytes show morphological and anatomical adaptations to reduce the transpiration and to retain the water inside the plant
g) **Calcium oxalate** crystals called **sphaeraphides** are found in *Nerium* leaf epidermis.
h) Epidermal cells of some grasses may have silica crystals.

PLANT SUCCESSION :

- The composition and structure constantly change in response to changing environmental conditions.
- These changes lead finally to a community that is in near equilibrium with the environment and that is **climax community**.
- This gradual and fairly predictable change in the species composition of a given area is called ***Ecological succession.***
- Succession is hence a process that starts where no living organisms are found. If it starts from areas where no living organisms ever existed eg.: bare rock it is **"Primary succession"**. If it starts from areas that some how lost all the living organisms that existed there Eg: abandoned farm lands, burned or cut forests or lands that have been flooded are **" Secondary Succession".**
- Secondary succession here occurs faster than primary succession.

SUCCESSION OF PLANTS :

- Based on nature of habitat - whether it is water (or very wet) or very dry - succession of plants is called **Hydrach** or **Xerarch**.
- **Hydrach succession :** takes place in wetter areas and succession progress to mesic conditions.
- **Xerarch succession :** takes place in dry areas and succession progress to mesic conditions.
- Both Hydrach and Xerarch succession lead to the Medium water conditions (mesic) - neither too dry (xeric) nor too wet (hydric)
- The species that invade a bare area are **pioneer species.**

Terms of community in succession :

Pioneer community : The first community to inhabit an area is called Pioneer community.

Climax community : The last and stable community in an area is called climax community. This is more stable. Usually mesophytes are present in climax community.

Seral communities or seral stage : In succession, communities or stages which comes in between pioneer community and climax community is called transitional or seral communities.

Sere : The entire series of communities is called sere. The name of sere depends on where the succession occurs or takes place.

Succession in fresh water	-	Hydrosere
Succession in salty water	-	Halosere
Succession in acidic water	-	Oxaloser
Succession in dry region	-	Xerosere
Succession on rocks	-	Lithosere
Succession on sand	-	Psamosere
Succession at moistured region	-	Mesosere
Succession of microbes on decomposed matters	-	Serula

HYDROSERE

Stages of hydrosere or hydrach succession in the newly formed pond or lake :

1. **Phytoplankton stage :** It is pioneer community, first coming from minute autotropic organism. These produce organic matter. E.g. Soft mud diatom, Cyanobacteria.
2. **Rooted submerged stages :** E.g. *Vallisneria*
3. **Rooted floating stages :** E.g. *Nymphaea*, *Nelumbium*, *Trapa*.
4. **Reed swamp stage (amphibious stage) :** Most part of these rooted plants remain exposed to air. E.g. *Typha*, *Saggitaria*
5. **Sedge (Meadow stage or marsh meadow stage) :** Muddy plants. E.g. *Carex*, *Ipomoea*
6. **Scrub stage :** Woody shrubs, tolerates water loggin. E.g. Cornus
7. **Forest stage :** E.g. Tree

LITHOSERE

Stages of lithosere (Succession on rocks)

1. **Crustose lichens stage :** It is pioneer community, tolerates desiccation, produces organic acid which causes weathering of rocks, so first minerals are released for their own use.
   E.g. *Rhizocarpon*
2. **Foliose lichens stage :** Large lichens with leafy thalli.
3. **Moss stage :** E.g. *Polytrichum*
4. **Herb stage :** Annual hardy grasses. E.g. *Poa*, *Eleusine*, *Artistida*.
5. **Shrub stage :** E.g. *Zizyphus*
6. **Forest stage :** E.g. Tree

ECOLOGICAL SERVICES / ECOSYSTEM SERVICES :

- Many valuable goods like air, water, food, fuel, fibre, genetic resources, pharmaceutical products are essential to our survival for natural ecosystem.
- Plants help this by capturing energy of sun and combine it with water and nutrients from soil and carbondioxide from atmosphere and thus manufacture food for use by the organisms.

PRICE TAGS OF ECOLOGICAL SERVICES :

- Our dependence on ecosystem services is complete but poorly understood.
- Many of these services are non-market services by virtue of their inherent characteristics eg. both the atmospheric ozone layer and climate stability provided by global carbon cycle cannot be owned by anyone who can control their use by others
- Researchers have put an average price tag of US$33 million a year on these fundamental ecosystems service, which are largely taken for granted because they are free. This is nearly twice the value of Global gross National Product (GNP) US $18 trillion
- Ecosystem services are grouped into four broad categories
- **Supporting services** - nutrient cycling, oxygen production soil formation and crop pollinaton
- **Provisioning services** : food, fibre, fuel and water
- **Regulating services :** climate regulation, water purification and flood protection
- **Cultural services -** education, recreation, aesthetic value.

  Out of total cost of various ecosystem services, soil formation accounts for about 50%, the services like recreation and nutrient cycling are less than 10% and climate regulation and habitat for wildlife to about 6%.

ECOSYSTEM SERVICE - POLLINATION :

- Pollination is the transfer of pollen grains to fertilize the ovaries of flowers - is an essential part of healthy ecosystem.
- The pollinators helps in the production of fruits, seeds & most important pollinator is **honey bee.**
- Predicting the effects of the loss of a particular pollinator is extremely difficult, but it is important to remember that no species exists in isolation. Each is part of an ecological web and as we lose more and more pieces of that web, the remaining structure must eventually collapse.
- Pollination of crops by bees is required for 15-30% of U.S. food production most large - scale farmers import non-native honey bees to provide this service.
- Wild bees alone could provide partial or complete pollination services and enhance it.
- Pollinators come in all shapes & sizes, Over 1,00,000 invertebrate species - such as bees, moths, butterflies, beetles and flies serve as pollinators.
- About 1,035 species of vertebrates - birds, mammals, reptiles pollinate many plant species.
- Pesticides are major threat to insect pollinators

MEASURES TO PROTECT POLLINATORS :

- Creating own pollinator - friends garden
- Reducing level of pesticide
- Encouraging local cluts, artificial habitats such as butterfly gardens, bee boards, bee boxes.

ECOSYSTEM SERVICE - CARBON FIXATION

- Trees are essential to carbon sequestration, keeping excess carbon from entering the atmosphere.
- The main chemical flow between forest and atmosphere is the exchange of CO_2 and O_2 by photosynthesis.
- CO_2 amount absorbed to produce 1gm dry organic matter can be calculated as per photosynthetic equation 180g. of glucose and 192g of O_2 absorb 264g CO_2 and 108 g water and consume 677.2 k.cal. of solar energy.
- Then 180g glucose can be transformed to 162 g polysachharide inside plants.
- So, whenever 162 g dry organic matter is produced 264 g CO_2 will be fixed i.e. 1g dry organic matter can fix 1.63 g CO_2.
- The economic value of CO_2 fixation can be estimated by total fixed CO_2 amount multiplied by a standard opportunity cost for per unit CO_2 fixation.
- The Natural ecosystem help to stabilize climate and prevent over heating of earth by removing more greenhouse gas carbon dioxide from the atmosphere.

ECOSYSTEM SERVICE - OXYGEN RELEASE :

- Atmosphere of earth has different composition of gases due to the biochemical reactions of earth's organisms.
- A mature leafy tree produces as much O_2 in a season as 10 people inhale a year.
- A single mature tree can absorb carbondioxide at a rate of 48 *l*bs/year and release enough oxygen back into the atmosphere to support two human beings.
- **One acre of trees annually** consumes the amount of carbon dioxide equivalent to that produced by driving an average **car for 26,000 miles**. That same acre of trees also produces enough oxygen for **18 people to breathe for a year**.
- The plants and planktons are sometimes described as **" the lungs of world"** taking billions tons of CO_2 from atmosphere and through photosynthesis **" exhaling"** billions of tons of the atmospheric O_2 that we breathe.
- Microorganisms also contribute to oxygen release in direct and indirect ways
  Eg.: *Cyanobacteria releases directly*.
- Supporting services include, Nutrient cycling through decomposition of fallen logs in forests, soil formation by bacteria and lichens.
- the provisioning services include providing food Fibre, fuel (Fossil fuels petrocrops).
- Regulating services include, temperature regulation by afforestation, water purification by microbes and flood protection by plants such as mangroves like sunderbans in West Bengal.
- The cultural services can be exemplified by conservation of plant biodiversity and creating natural (Aesthetic) beauty through local gardens.

HOW TO SUSTAIN ECOLOGICAL FUNCTIONS:

Cultivate the following practices in our day to day life as a part of the solution to protect the ecological functions from contemporary threats.

- Choose products which conserve resources, minimize waste and reduce or eliminate environmental damage.
- Prefer products made with methods that reduce or eliminate the use of pesticides and artificial fertilizers.
- Reduce consumption and waste production
- Support usage of renewable energy alternatives
- Use public transit, cycle or walk to conserve natural resources and to reduce pollution and enjoy health benefits.
- Participate in developing community garden or tree plantation programmes
- Avoid the usage of pesticides and follow methods of natural pest control
- Use native plants in garden and provide habitat for wild life.

MODEL TEST - I

1. Who classified the plant communities in to three major ecological groups
   1) Haeckel 2) Hofmeister
   3) Warming 4) Odum
2. CAM plant among the following
   1) *Opuntia* 2) *Hibiscus*
   3) *Cucurbita* 4) All the above
3. Submerged rooted hydrophyte from the following
   1) Nymphaea 2) Utricularia
   3) Limnophila 4) Vallisneria
4. The plants which grow in shady places are called
   1) Sciophytes 2) Hydrophytes
   3) Xerophytes 4) Mesophytes
5. Plant floating on water and useful as biofertilizer in rice fields is
   1) Lemna 2) Azolla
   3) Wolffia 4) Salvinia
6. Aerenchyma tissues helps in gaseous exchange and buoyancy in the following plants
   1) All hydrophytes 2) All xerophytes
   3) All mesophytes 4) All sciophytes
7. Hydrophytes like *Nymphaea and Nelumbo* are
   1) Free floating hydrophytes
   2) Amphibious plants
   3) Submerged rooted hydrophytes
   4) Rooted plant with free floating leaves.
8. Water storage tissue is present in
   1) Acacia 2) Opuntia
   3) Calotropis 4) Hydrilla
9. Tribulus an ephemeral plant completes is life cycle with in
   1) 6-8 weeks 2) 10-12 days
   3) 40-50 weeks 4) 10-12 years
10. Mechanical tissues and xylem are well developed in
    1) xerophytes 2) hydrophytes
    3) Mesophytes 4) Sciophytes
11. The correct pair of plants, which can with stand prolonged period of drought
    1) Casuarina and Tribulus
    2) Nerium and Tribulus
    3) Ziziphus and Tribulus
    4) Casuarina and Calotropis
12. Succulent fasciculated roots are found in
    1) Aloe 2) Opuntia
    3) Asparagus 4) Agave
13. Submerged hydrophytes have
    1) Stomata on both surfaces of leaf
    2) Stomata on upper leaf surface
    3) No stomata
    4) Stomata on lower surface of leaf
14. True xerophytes are
    1) Ephemeral plants
    2) Succulent plants
    3) Non-Succulent plants
    4) None of the above
15. The following plant epidermal cells contain silica crystals.
    1) Xerophytic plants 2) Hydrophytes
    3) Sciophytes 4) Mesophytes

MODEL TEST - II

16. Succession on Bare rock is
    1) Primary succession 2) Secondary succession
    3) Tertiary succession 4) None of the above
17. Succession takes place in fresh water is
    1) Xerosere 2) Oxalosere
    3) Hydrosere 4) Lithosere
18. The species that invade a bare area is
    1) Climax Species 2) Pioneer species
    3) Seral communities 4) None of the above
19. The succession that takes place on sand is
    1) Psammosere 2) Lithosere
    3) Serula 4) hydrosere
20. The pioneer community in hydrosere is
    1) Phytoplanktons

2) Rooted submerged hydrophyts
3) Amphibious hydrophyts
4) Mesophytes.

21. Succession in cut forest is
1) primary succession 2) Secondary succession
3) Lithosere 4) None of the above

22. The last & stable community in plant succession is
1) Pioneer community 2) Seral community
3) Climax community 4) None of the above

23. Flood protection comes under the following ecological services
1) Supporting service 2) Provisioning service
3) Regulating service 4) Cultural services

24. Which one of the following ecological services are come under supporting services
1) Climate regulation 2) Recreation
3) Soil formation 4) Water purification

25. Most important pollinator among the following
1) Birds 2) Honeybees
3) Snakes 4) Butterflies

26. Number of vertebrate species involved in pollination
1) 1, 00,000 2) 10, 035
3) 1, 035 4) 15, 035

27. Number of grams of polysaccharide formed from 180 grms of glucose
1) 180g 2) 178g
3) 162g 4) 18g

28. Lungs of the world are
1) Plants 2) Phyto planktons
3) Zooplanktans 4) 1 & 2

29. Sundarbans in west bengal are examples for
1) Regulating services 2) Provisioning services
3) Cultural services 4) Supporting services

30. Which one of the following is not a measure to protect pollinators
1) Creating own pollinator - friendly gardens
2) Increasing level of pesticides
3) Encouraging bee gardens
4) Encouraging local clubs

QUESTION BANK
TYPE - I

31. Mangrove plant in sunderban-delta are adapted to tolerate :
1) High temperature 2) High salinity
3) Temperature extremes 4) None of these

32. Germination of seeds when the fruits are still attached with the mother plant is referred to as :
1) Adventive embryony 2) Ovipary
3) Vivipary 4) None of these

33. The study of organisms is relation to their environment is the definition of
1) Morphology 2) Ecology
3) Embryology 4) Biome

34. The term "ecology" was first used by
1) Reiter 2) Warming 3) Tansley 4) Odum

35. Who of the following defined ecology as the study of structure and function of nature?
1) Reiter 2) E.P. Odum
3) Haeckel 4) Warming

36. Organisms of same species living in an area are called
1) Population 2) Community 3) Fauna 4) Flora

37. If you arrange the different levels of organisation in the table below in a hierarchy, the level of organisation found three levels below a plant or an individual

Organism (plant or an individual)	Community	Organs
Ecosystem	Population	Biosphere
Tissue	Cell	Organ systems

1) Organs 2) Biosphere 3) Cell 4) Tissue

38. *Hydrilla* is a :
1) Hydrophyte with poorly developed roots
2) Rooted and rhizomatous hydrophyte
3) Free-floating hydrophyte
4) Attached floating hydrophyte

39. A free-floating hydrophyte which belongs to vascular cryptogams and is commonly used as biofertilizer, is :
1) Salvinia 2) Pistia
3) Spirodela 4) Azolla

40. The insectivorous plant *Utricularia* grows in ponds and lakes as :
1) Free-floating hydrophyte
2) Submerged hydrophyte
3) Attached-floating hydrophyte
4) Marshy hydrophyte

41. The National flower (Lotus) plant is a
1) fixed floating 2) free floating
3) amphibious plant 4) submerged plant
42. Typha is a
1) Attached emergent plant
2) Marshy plant
3) Free floating 4) None of the above
43. Smallest angiosperm with short life span
1) *Utricularia* 2) *Spirogyra*
3) Lemna minor 4) *Wolffia microscopica*
44. Water hyacinth (*Eichhornia crassipes*) is a hydrophyte with
1) Offsets 2) balancing roots
3) 1 & 2 4) large peltate leaves
45. Which of the following is amphibious in nature ?
1) *Vallisneria* 2) *Trapa*
3) *Ranunculus* 4) Hydrilla
46. Aquatic free-floating plants are :
1) *Pteris* and *Pteridum*
2) *Dryopteris* and *Adiantum*
3) *Azolla* and *Salvinia*
4) *Lycopodiom* and *Selaginella*
47. Rooted submerged plant is :
1) *Wolffia* 2) *Vallisneria*
3) *Nelumbo* 4) *Utricularia*
48. Suspended hydrophyte leading insectivorus life is
1) Certatophyllum *2) Utricularia*
3) Dionaea *4) Nepenthes*
49. Plant floating on water and useful as biofertilizer in rice fields is
1) Azolla *2) Lemna*
3) Wolffia *4) Salvinia*
50. The hydrophyte that have contact with water only
1) Nymphaea *2) Ceratophyllum*
3) Vallisneria *4) Typha*
51. Find the pair of hydrophytes that are niether in contact with soil nor air
1) Vallisneria, Hydrilla
2) Hydrilla, Utricularia
3) Salvinia, Azolla
4) Limnophila, Ceratophyllum
52. Select the pair of plants that show contact with soil and water, but not with air
1) Potamogeton, Vallisneria
2) Hydrilla, Ceratophyllum
3) Wolffia, Sagittaria
4) Cyperus, Typha
53. Submerged plant among of the following
1) Hydrilla *2) Pistia*
3) Lotus *4) Water lily*
54. Typha is an example of
1) Free floating plant 2) Submerged plant
3) Floating and attached 4) Emergent plant
55. Hydrophytes like Nymphaea and Nelumbo are
1) Free floating hydrophytes
2) Amphibious plant
3) Submerged rooted hydrophytes
4) Rooted hydrophytes with free floating leaves
56. Heterophylly is found in :
1) *Limnophila* 2) *Ranunculus*
3) *Sagittaria* 4) All of these
57. Leaves are epistomatic in :
1) *Nelumbo* 2) *Hydrilla*
3) *Najas* 4) *Eichhornia*
58. Astomatiferous leaves are seen in :
1) Free-floating hydrophytes
2) Submerged plants
3) Emergent plants 4) Marshy plants
59. In submerged hydrophytes, gaseous exchange takes place through :
1) Diffusion from entire body surface
2) Leaves having lenticels
3) Openings developed on stem and leaves
4) None of the above
60. Respiratory and floating roots develop in :
1) *Nymphaea* 2) *Jussiaea*
3) *Trapa* 4) *Lemna*
61. Epidermis is chlorophyllous in sterm of :
1) *Hydrilla* 2) *Bryophyllum*
3) *Mangifera* 4) None of these
62. In submerged hydrophytes, leaves have :
1) Highly differentiated mesophylls
2) Undifferentiated mesophylls
3) Highly developed vascular tissue
4) Thick layer of cuticle
63. The chief anatomical feature of all hydrophytes is
1) absence of stomata
2) sunken stomata
3) well developed aerenchyma
4) well developed xylem
64. Submerged hydrophytes have
1) stomata on both surface
2) stomata on leaf surface
3) no stomata 4) stomata on lower surface

65. The stem of submerged water plants is soft and weak because
1) they are absolutely devoid of xylem
2) they totally lack phloem
3) they do not have stomata
4) the supporting tissue and xylem are poorly developed

66. Epidermis is useful for both absorption and assimilation in
1) Mesophytes 2) Mangroves
3) Xerophytes 4) Hydrophytes

67. In submerged hydrophytes, gaseous exchange occurs through
1) Hydathodes 2) Stomata
3) General body surface
4) Injured parts

68. Useful adaptation for hydrophytes
1) large leaves
2) decrease in mechanical tissue
3) large mechanical tissue
4) increase in aerenchyma

69. Anatomically all hydrophytes are similar in having
1) Aerenchyma 2) Collenchyma
3) Stomata 4) Cuticle

70. Ephemerals are :
1) Annual plants surviving only one year
2) Plants of very short life cycle or drought escaping plants
3) Amphibians growing commonly on swamps
4) Perennial surviving many years

71. Ephemerals closely resemble morphologically as well as anatomically to a normal
1) Xerophytes 2) Succulents
3) Mesophytes 4) Halophytes

72. Ephemerals are placed in xerophytes as they have :
1) Needle like leaves to reduce transpiration
2) Leaves modified to spines
3) Phyllodes or cladodes to protect moisture
4) Short life span to escape hot summer period

73. Ephemeral plants are categorised under
1) Drought enduring plants
2) Drought escaping plants
3) True xerophytes
4) Drought avoiding plants

74. Drought avoiding plants are
1) Hydrophytes 2) Mesophytes
3) Succulents 4) Parasites

75. Which one suffers from both external and internal dryness
1) Opuntia *2) Zizyphus*
3) Tribulus *4) Aloe*

76. The xerophyte with succulent phylloclades
1) Casuarina *2) Ruscus*
3) Aloe *4) Opuntia*

77. True xerophytes are
1) Ephemeral plants of deserts
2) Succulent plants
3) Non-succulent perennials
4) None of the above

78. Identify a pair of xerophytes, whose aerial parts are succulent
1) Asparagus and Ceiba
2) Ceiba and Aloe
3) Opuntia and Bryophyllum
4) Asparagus and Aloe

79. Water storage tissue is present in
1) Acacia *2) Opuntia*
3) Calotropis *4) Hydrilla*

80. The ephemeral *Tribulus* tide over the dry conditions
1) by its tuberous stem 2) by its aerial stem
3) in the form of seeds
4) by storing water in different parts of its body

81. The correct pair of plants, which can withstand prolonged period of drought
1) Casuarina, Tribulus
2) Nerium, Tribulus
3) Ziziphus, Tribulus
4) Casuarina, Calotropis

82. Phylloclade differs from cladode in having :
1) Spines 2) Many internodes
3) Stem modification 4) None of these

83. Thicky cuticularized epidermis, sunken stomata and compact mesophylls are found in leaves of :
1) *Cycas* 2) *Pinus*
4) *Nerium* 4) All of these

84. *Casuarina* lacks well developed :
1) Leaves 2) Stem
3) Roots 4) Flowers

85. Well developed mechanical tissue and vascular strands are always found in:
1) Ephemerals 2) Halophytes
3) Drought enduring plants
4) None of these

86. Extreme xerophytic modification is best seen in :
1) *Nerium* 2) *Cacti*
3) *Cycas* 4) *Capparis*

87. Higher root : Shoot ratio is found in :
1) Halophytes 2) Epiphytes
3) Psammophytes 4) Oxalophytes

88. Very poor root : shoot ratio can be seen in :
1) *Vallisneria* 2) *Nelumbo*
3) *Hydrilla* 4) *Opuntia*

89 Sunken stomata are present in
1) Xerophytes 2) Hydrophytes
3) Mesophytes 4) All the above

90. Sunken stomata and multiple epidermis occur in
1) *Hydrilla* 2) *Mangifera*
3) *Nerium* 4) *Vallisneria*

91. Multiple epidermis, sunken stomata, with stomatal hairs in Nerium leaf represent
1) Xerophytic adaptation
2) Mesophytic adaptation
3) Hydrophytic adaptation
4) Halophytic adaptation

92. An adaptation usually found in many xerophytes is
1) Thin epidermis 2) Stomata in pits
4) Waxy coating 4) Thick spines

93. A feature useful to minimise water loss in xerophytes is
1) Extensive root system 2) Thick cuticle
3) Well developed water storage parenchyma
4) Undivided lamina

94. Succession starts in a :
1) Barren pond or lake 2) Forest range
3) Well colonized land 4) Grassland ecosystem

95. Succession is a :
1) Long term process 2) A very slow process
3) Law of nature 4) All of these

96. Succession is related with :
1) Migration of taxa 2) Origin of species
3) Extinction of certain species during interactio with environment 4) All of the above

97. A succession which starts in a forest area after deforestation is :
1) Heterotrophic succession
2) Allogenic succession 3) Autogenic succession
4) Secondary succession

98. Ecesis refers to :
1) Migration 2) Invasion
3) Establishment 4) Aggregation

99. Reed swamp stage is a seral community of :
1) Lithosere 2) Hydrosere
3) Psammosere 4) Mesosere

100. Pioneer community of hydrosere is represented by :
1) Phytoplanktons 2) Free-floating stage
3) Submerged stage 4) Reed swamp stage

101. A dynamic equilibrium is established between community and environment when :
1) Climax is attained 2) Pioneers are found
3) Seral communities are growing
4) None of the above

102. Climax community of hydrosere is :
1) Free-floating stage 2) Forest
3) Grass land 4) Marsh stage

103. Pioneer community of psammosere is :
1) Crustose lichen stage
2) Foliose lichen stage
3) Blue-green algae
4) sedges and grasses

104. Crustose lichens are pioneers of :
1) Halosere 2) Hydrosere
3) Lithosere 4) Psammosere

105. Heterotrophic succession occurs on :
1) Barren soil 2) Sand dunes
3) Decaying debris 4) Climax community

106. Find out the correct sequence of seral communities in hydrosere :
1) Submerged stage, floating leaved stage, reed swamp stage.
2) Free-floating stage, submerged stage, emergent stage.
3) Marsh stage, floating leaved stage, submerged stage, floating stage.
4) None of the above

107. *Eichhornia*, *Salvinia*, Azolla, *Wolffia*, *Spirodela* and *Lemna* grow in ponds and lakes during :
1) Pioneer stage of succession
2) Free-floating stage
3) Attached emergent stage
4) Reed swamp stage

108. Bryophytes have some ecological importance as they are the first to colonized.
1) In a barren pond 2) In a barren forest
3) On a barren rock 4) None of these

109. In hydrosere reed swamp stage is followed by :
1) Marsh stage 2) Shrub stage
3) Woodland stage 4) Free-floating stage

110. In hydrosere *Hydrilla* and *Vallisneria* appear after the :
1) Floating leaved stage 2) Free-floating stage
3) Phytoplankton stage 4) Herbaceous stage

111. 'Struggle for existence' and 'survival of fittest' occur in
1) Pioneers 2) Seral communities
3) Aggregation and ecesis process
4) All of the above

112. In plant succession when climax is reached the net productivity :
1) Continues to increase 2) Becomes half
3) Becomes stable 4) Becomes zero

113. Primary succession takes much longer time than secondary succession because it involves
1) Colonization by organisms
2) Development of soil
3) Development of seeds bank 4) All the above

114. Primary succession refers to development of communities on a
1) Newly exposed habitat with no record of earlier vegetation.
2) Pond freshly filled with water after a dry phase
3) Forest clearing after devastating fire
4) Freshly cleared crop field.

115. An orderly sequence of community development on an area is called
1) Succession 2) Cover
3) Establishment 4) Diversity

116. The terminal stage of a successional process is called
1) Final stage 2) Climax stage
3) Seral stage 4) Pioneer stage

117. A community that is in near equilibrium with the environment during ecological succession is
1) Trophic level 2) Food chain
3) Climax community 4) Food web

118. Succession starts on the large rock is called
1) Secondary succession
2) Primary succession 3) Climax community
4) Ecological pyramids

119. How much of CO_2 absorb for the production of 180g of glucose in plants
1) 193g 2) 264g 3) 180g 4) 162g

120. How much solar energy consume when plants release 193g of O_2
1) 677.2 k.cal 2) 877.2 k.cal
3) 777.2 k.cal 4) 776.2 k.cal

121. Inside the plant 180g of glucose can be transformed to _____ g of polysaccharide.
1) 165g 2) 180g
3) 162g 4) 264g

122. For the production of every 1g dry organic matter, plants can fix _____g of CO_2
1) 1.63g 2) 2.63g
3) 3.63g 4) 0.63g

123. The following is considered as greenhouse gas
1) N_2 2) O_2
3) CO_2 4) H_2S

124. The amount of oxygen produced by a tree depends on the
1) species of tree 2) its age
3) its health and the surrounding trees
4) all the above.

125. One acre of trees annually consume the amount of carbon dioxide equivalent to that produced by driving an average car for _____ miles
1) 36,000 miles 2) 26,000 miles
3) 16,000 miles 4) 46,000 miles

126. Oxygen produced by the plants in 1acre area sufficient to breath how many people
1) 10 people 2) 5 people
3) 15 people 4) 18 people

127. The following are considered as the lungs of the world.
1) plants and planktons 2) plants only
3) panktons only
4) plants and animals.

128. The following microorganism release oxygen directly
1) *Nostoc* 2) *Anabaena*
3) Bacteria 4) a & b

129. According to Millennium Ecosystem Assessment ecosystem services are grouped into this many categories
1) 3 2) 2 3) 4 4) 5

130. One of the following is not a supporting ecosystem services
1) Nutrient cycling 2) Oxygen production
3) Soil formation 4) Climate regulation

131. Ecosystem services such as education, recreation and aesthetic value comes under this category
1) Regulating services 2) Supporting services
3) Cultural services
4) Provisioning services

132. Identify the correct statement
1) cost of soil formation account for about 10 percent
2) food, fibre are regulating services
3) recreation and nutrient cycling accounts for less thatn 10 percent
4) water purification and food production are supporting services

133. The most important pollinator for agricultural purposes is
1) Flies 2) Mosquitoes
3) Cockroaches 4) Honey bees

134. To produce 1 gm dry organic matter the amount of CO_2 fixed is
1) 1.98 gm 2) 20 gm
3) 1.63 gm 4) 40 gm

135. Natural ecosystem may have helped to stabilize climate and prevent overheating of the Earth by removing more of
1) The green house gases from atmosphere
2) CO_2 from the atmosphere
3) ground water 4) a and b

136. The purpose of developing a carbon tax system in many countries is to
1) reduce green house gases
2) cut down CO_2 in atmosphere
3) cut down CO in atmosphere 4) All the above

137. An effective measure to prevent global warming is
1) Drip-irrigation 2) afforestation
3) to provide growth chambers
4) none

138. Submerged suspended hydropytes ares
1) Potamogeton *2) Cyperus*
3) Lemna *4) Hydrilla*

139. The study of organisms in relation to their environment is known as
1) Morpholgoy 2) Ecology
3) Embryology 4) Biome

140. Who among the follwoing defined ecology as structure and function of nature
1) Warming 2) Haeckel
3) Odum 4) Tanskey

141. Organism of same species living in an area are called
1) Population 2) Community
3) Fauna 4) Flora

142. The assemblage of all the population belonging to different species occuring in an area is called
1) Population 2) Ecosystem
3) Biosphere 4) Community

143. The bilogically inhabited part of earth consisting of all ecosystems of the world as
1) Population 2) Biometry
3) Biosphere 4) Community

144. Structural and functional of nature is called
1) Ecosystem 2) Ecology
3) Biome 4) Biosphere

145. Which is considered as a giant ecosystem?
1) Pond 2) Grass land
3) Forest 4) Earth

146. Classification of plant communities was given by
1) Warburg 2) Wareing
3) Haeckel 4) Warming

147. The correct sequence of levels of organization present in the body of evovled
A) Cells B) Organs
C) Tissue system D) Tissue
1) D,A,B,C 2) A,B,C,D
3) A,D,C,B 4) C,B,D,A

148. Arrange the following in ascending order of complexity
I) Biosphere II) Community
III) Ecosystem IV) Population
1) I, III, II,IV 2) III, I, II, IV
3) IV, II, III, I 4) IV, III, II, I

149. The angiospermic hydrophyte which floats freely on the surface of water
1) Victoria 2) Wolffia
3) Ranunculus 4) Cyperus

150. Submerged and suspended hydrophyte is
1) Salvinia 2) Ceratophyllum
3) Wolffia 4) Potamogeton

151. Submerged rooted hydrophyte with ribbon shaped leaves
1) Valisneria 2) Nymphaea
3) Hydrilla 4) Utricularia

152. Plant having contact neither with soil nor air is
1) Hydrilla 2) Cyperus
3) Potamogeton 4) Trapa

153. Suspended hydrophyte leading insectivorous life is
1) Ceratophyllum 2) Utricularia
3) Drosera 4) Nepenthes

154. Which of the following is an amphibious plant?
1) Hibiscus 2) Cyperus
3) Dolichos 4) Ceratophyllum

155. A hydrophyte which can survive even in dry periods for some time is
1) Nymphaea 2) Cyperus
3) Nelumbo 4) Vallisneria

156. Rooteless suspended hydrophyte is
1) Nelumbo 2) Wolffia
3) Utricularia 4) Ceratophyllum

157. The stem of submerged plant is soft and weak because
1) They are abosultely adevoid of xylem
2) Totally lack phloem
3) Do not have stomata
4) The supporting tissues and xylem are freely developed

158. Identify the set constitued by submerged suspended hydrophytes
1) Victoria, Vallisneria, Ceratophyllum
2) Ceratophyllum, Utricularia
3) Utricularia, Potamogeton, Typha
4) Hydrila, Cyperus, Salvia

159. Hydrophyte showing hydrophilly is
1) Vallisneria 2) Typha
3) Sagittaria 4) Nymphaea

160. Root caps are absent in
1) Cyperus 2) Aloe
3) Eichhornia 4) Typha

161. In Pistia root caps are replaced by
1) Adventitious buds 2) Leaves
3) Root pockets 4) Root hairs

162. A hydrophyte with distinct root caps is found in
1) Typha 2) Eichhornia
3) Lemna 4) Pistia

163. Heterophyllous plant with hemi anatropous ovule is
1) Selaginella 2) Limniphila
3) Ranunculus 4) Acacia melanoxylon

164. Which is not a hydrophytic character?
1) Abundant and air chambers
2) Very well developed xylem and sclerenchyma
3) Leaves with stomata absent or only on upper side
4) Epidermal cells are thin walled

165. The type of parenchyma well developed in hydrophytes is
1) Xylem parenchyma
2) Water storage parenchyma
3) Aerenchyma
4) Phloem parenchyma

166. Pneumatophores are found in
1) Hydrophytes 2) Xerophytes
3) Mangrooves 4) Mesophytes

167. Stomatal condition in Nympheae is
1) Epistomatous 2) Hypostomatous
3) Non functional 4) Amphistomatous

168. Very well developed mechanical tissues and vasuclar tissues are seen in
1) Hydrophytes 2) Mesophytes
3) Xerophytes 4) Halophytes

169. The plants which grow in extremely dry conditions generally show the following adaptation?
1) Aerenchyna 2) Thin cuticle
3) Sunken stomata
4) Poorly developed xylem

TYPE - II

170. Identify the incorrect statements regarding Nerium
I) Leaves are leathery and whorled phyllotaxy
II) Sunken stomata and multiple epidermis
III) Leaf succulent and polychasial cyme
IV) Tap root systm and herbaceous stem
1) I & III 2) II & IV
3) I & II 4) III & IV

171. Identify the correct statements regarding the Bryophyllum
1) It contain reproductive leaves
II) Every leaf produce only one epiphyllous bud
III) Leaves are succulent
IV) It is a drought evader
1) I & II only 2) I & IV only
3) I, II&IV only 4) I & III only

172. Which of the following statement is incorrect
1) Epidermal cells of xerophytes possess thick walls
2) Dead simple tissue is abundant in submerged and suspended Hydrophytes
3) Root hairs and root caps are well developed in physical xerophytes
4) In xerophytes the surface of leaves is generally shiny and glazed.

173. Choose the correct statements with regard to xerophytic evidence in Opuntia
I) Leaves are modified into spines
II) Stem is modified phyllode
III) Succulent stem IV) Fleshy leaves
1) II and III 2) III and IV
3) I and III 4) I and II

174. Identify the incorrect statements
I) Salvinia is a free floating plant
II) Hydrilla is rooted and submerged plant
III) Utricular is submerged and suspended plants
IV) Cyperus lives partly in water partly in air
1) I and III 2) II only
3) III and IV 4) II and IV

175. Identify the correct statements with reference to Hydrilla
I) Stem is long, slender and flexible
II) Submerged suspended hydrophyte
III) Leaves are linear
IV) Reproduces by offsets
1) I and II 2) III and IV
3) II and IV 4) II and III

176. Elongated petiole, aggregate fruits and waxycoating on t he upper surface of leaf lamina are present in
1) Nymphaea 2) Clematis
3) Salvinia 4) Nelumbo

177. Choose the correct statements
I) Hydrilla stem is long slender and flexible
II) Aerenchyma helps for buoyancy
III) In some xerophytes shoot system is several times longer than the root system
IV) Multiple epidermis is present in Nerium
1) I & II only 2) II & III only
3) III & IV only 4) I, II & IV

178. Superficial placentation perispermic seeds and rhizomatous stem is foun din
1) Nymphaea 2) Nelumbo
3) Piper 4) Zinger

179. If a Nerium plant consists of 33 leaves on its stem (there leaves at each node) how many nodes and internodes are presents respectivley
1) 10,11 2) 11,10
3) 11,11 4) 33,32

180. Identify the correct statements among the following
I. Rhizophora is a halophyte
II. Plants grow in direct sunlight are sciophytes
III. Plants grow in saline areas are halophytes
IV. *Opuntia* is a CAM plant
1) I & III 2) II & III
3) I & IV 4) I, III & IV

181. Identify the incorrect statements among the following
I. *Limnophila* is an amphibious, heterophyllous hydrophyte
II. *Victoria regia* is a hydrophyte with root pockets
III. *Sagittaria* is a mesophyte
IV. In CAM plants stomata open during day time
1) I only 2) I & IV only
3) II & III 4) II, III & IV

182. Identify the correct statements from the following
I. Sandy soils contain about 40% of sand particals
II. Loam soil contain 20% clay, 40% sand and 40% silt.
III. The range of Gravel in soil is 1-2 mm
IV. Sandy soils contain 80% clay, 20% sand and 20 silt
1) I and IV 2) II and III
3) I & III 4) I, II & III

183. Identify the correct statements
I. *Bryophyllum* is an ephemeral plant
II. *Opuntia* is a leaf succulent
III. *Casuarina* is a perennial plant
IV. *Tribulus* is a xerophyte
1) I & II 2) II & III
3) III & IV 4) I, II & III

184. Identify the correct statements
I. Thick cuticle is present in hydrophytes
II. Stomata are completely absent in Hydrilla
III. Mechanical tissues are well developed in xerophytes
IV. Epistomatous leaves are present in Potamogeton
1) I & II 2) II & III
3) I & IV 4) III & IV

185. The group of plants which are in contact with soil, water & air are
I. *Nelumbo* II. *Potamogeton*
III. *Typha* IV. *Lemna*
1) I & III 2) II & IV
3) I, II & III 4) I only

186. In photosynthesis to produce 180g of glucose & 193 g of O_2, plant will absorb ___ g of CO_2 & _____ g of water & consume ___ K cal of solar energy
1) 264,108,677.2 2) 260,106,677.2
3) 264,106,677.2 4) 264,108,667.2

187. Arrange the following communities of hydrosere in a correct sequence.
I) Scrub stage II) Submerged plant stage
III) Forest stage IV) Marsh meadow stage
V) Reed swamp stage
1) II, V, IV, I, III 2) III, I, IV, V, II
3) II, IV, V, III, I 4) IV, V, II, I, III

TYPE - III

188.

	Plant name	**mode of living in water**
	A. *Hydrilla*	I. Free floating hydrophyte
	B. *Typha*	II. Rooted hydrophyte with floating leaves
	C.*Nymphaea*	III. Submerged suspended hydrophyte
	D. *Lemna*	IV. Amphibious plant
	E.*Vallisnaria*	V. Mesophyte
		VI. Submerged Rooted hydrophyte

	A	B	C	D	E
1)	III	IV	II	I	VI
2)	IV	III	II	V	I
3)	I	II	IV	III	V
4)	II	IV	III	I	V

189.

Plant name	**mode of living in water**
A. *Limnophylla*	I. Floating free in water
B. *Pistia*	II. Pteridophyta
C. *Victoria regia*	III. Roots are fixed substratum
D. *Utricularia*	IV.Completely submerged
E. *Selvinia*	V. Amphibious plant.

	A	**B**	**C**	**D**	**E**
1)	II	IV	V	III	I
2)	I	III	II	V	IV
3)	V	I	III	IV	II
4)	III	II	IV	I	V

190. Match the following

Colum-I	**Colum-II**
A. Epistomatous	I. *Jussiaea*
B. Multiple epidermis	II. *Pistia*
C. Respiratory roots	III. *Nerium*
D.Root pocket	IV. *Sagittaria*
	V. *Nymphaea*

	A	**B**	**C**	**D**
1)	III	II	IV	I
2)	V	III	I	II
3)	I	IV	II	III
4)	II	I	III	IV

191. Match the following

Colum-I	**Colum-II**
A. Stomatal hairs	I. Epidermal cell of xerophytes
B. Aerenchyma	II. *Nerium*
C. Silica crystals	III. *Hydrilla*
D.Ephemerals	IV. *Tribulus*
	V. Nymphaea

	A	**B**	**C**	**D**
1)	I	IV	V	II
2)	III	I	II	IV
3)	II	III	I	V
4)	IV	V	III	I

192.

List -I	**List-II**
A. *Hydrilla*	I. cladophylls
B.*Nerium*	II.cuticle absent
C.*Asparagus*	III. multiple epidermis
D. *Eichhornia*	IV. Spongy petiole
	V. Aerenchyma

	A	**B**	**C**	**D**
1)	I	IV	III	II
2)	II	III	I	IV
3)	III	II	IV	I
4)	IV	I	II	III

193. **List -I** **List-II**
A. Hydrophytes I. *Nerium*
B. Xerophytes II. *Lemna*
C. Mesophytes III. *Rhizophora*
D. Halophytes IV. Barley

	A	**B**	**C**	**D**
1)	IV	III	I	II
2)	I	II	III	IV
3)	II	I	IV	III
4)	III	IV	II	I

194. **List -I** **List-II**
A. Indian Father of Ecology I. Robert constanza
B. Classified plant Communities II. Haeckel
C. Father of Ecology III. Ramdeo Misra
D. Price tags on nature's life support services IV. Eugen Warming
V. A.P. de candole

	A	**B**	**C**	**D**
1)	IV	II	I	III
2)	I	III	V	IV
3)	III	IV	II	I
4)	II	V	III	IV

195. **List -I** **List-II**
A. Ephemerals I. All temperate forests
B. Succulents II. *Tribulus*
C. Non-succulents III. *Opuntia*
D. Mesophytes IV. *Casuarina*
V. *Hydrilla*

	A	**B**	**C**	**D**
1)	I	II	III	IV
2)	II	III	IV	II
3)	III	IV	II	I
4)	IV	I	V	III

196. **List -I** **List-II**
A. Aerenchyma I. water storage
B. Mucilage II. photosynthesis
C. Selerenchyma III. buoyancy
D. Chlorenchyma IV. Mechanical support

	A	**B**	**C**	**D**
1)	I	II	III	IV
2)	IV	III	II	I
3)	III	I	IV	II
4)	II	IV	I	III

197. **List -I** **List-II**
A. Population I. Part of the earth consisting of all the ecosystem in theworld
B. Community II. Assemblage of all the individuals belonging to different species becoming area
C. Ecosystem III. Group of similar individuals belonging to the same species found in a aera
D. Ecosphere IV. Interaction between the living organism and the physical environmental components
V. Classification of organism based on the type of environment

	A	B	C	D
1)	IV	I	III	V
2)	I	III	II	IV
3)	III	II	IV	I
4)	II	IV	V	II

198. **List - I** **List - II**
A. Pimary succession I. Barren lake
B. Reed swamp stage II. Forest
C. Climax stage III. Rooted Hydrophytes
D. Pioneers IV. Small phyto planktons

	A	B	C	D
1)	I	III	II	IV
2)	III	II	IV	I
3)	II	IV	I	III
4)	IV	I	III	II

EXERCISE - IV

199. Study the following table
I. Ephemerals - Drought evaders - *Tribulus*
II. Leaf succulent - Drought avoiding plant - *Opuntia*
III. Non-succulent - True xerophyte - *Zizipus*
IV. Root succulent - Drought escaper - *Agave*
Identify the wrong combinations
1) I & II 2) II & III
3) II & IV 4) I & IV

200. Study the following table
I. *Nerium* - Hypostomatic - Scale leaves
II. *Calotropis* - Epistomatic - Rhizome
III. *Nymphaea* - Epistomatic - Rhizome
IV. *Vallisneria* - Astomatic - Ribbon Like leaves
Which two taxes show the correct combination
1) I & II 2) II & III
3) I & IV 4) III & IV

201. Study the following table and identify the correct combination

Plants	*Nature of leaf*	*Ecological type*
I. *Tribulus*	Highly reduced	Drought avoider
II. *Opuntia*	Phylloclade	Drought avoider
III. *Asparagus*	Scale leaf(or)spine	Drought avoider
IV. *Nerium*	Fleshly, Succulent	Non succulent

1) I & II 2) III & IV
3) III only 4) IV only

EXERCISE - V

202. Special kind of roots called pneumatophores are characteristics of plants growing in :
1) Sandy soils of deserts **CBSE2000**
2) Saline and waterlogged soils found near sea shore
3) Dry soils of user land
4) Waterlogged soils of ponds and lakes

203. Velamen is found in : **CPMT-2001**
1) Ferns 2) Orchid roots
3) Orchid flowers 4) Halophytes

204. Stem of submerged hydrophytes is highly reduced or elastic or even absent because :**CPMT-2000**
1) The Vascular bundle are absent
2) Mechanical tissues and vascular strands are poorely developed
3) Stomata are absent
4) None of the above

205. Which is an amphibious plant ? **CPMT-2000**
1) *Casuarina* 2) *Hydrilla*
3) *Polygonum* 4) *Wolffia*

206. Velamen tissue is found in : **BCECE-2001**
1) Mesophytes 2) Epiphytes
3) Hydrophytes 4) Xerophytes

207. Which of the following is having both hydrophytic as well as aerophytic character ? **CPMT-2001**
1) *Typha* 2) *Ranunculus*
3) *Ceratophyllum* 4) *Nerium*

208. Which of the following weed must be removed from the field before cropping ? **AFMC-2002**
1) *Eichhornia* 2) *Euphorbia*
3) *Agave* 4) *Azolla*

209. An example of physiological xerophyte :
1) *Salvinia* 2) *Euphorbia*
3) *Agave* 4) *Salicornia*

210. Which one of the following does not have stomata? **AFMC-2002**
1) *Eichhornia* 2) *Nelumbo*
3) *Nymphaea* 4) *Hydrilla*

211. Heterophylly of *Limnophila* is : **BHU-2002**
1) Environmental 2) Developmental
3) Habitual 4) Adaptive

212. One internode long phylloclade is found in :
1) *Ruscus* 2) *Opuntia* **BHU-2007**
3) *Asparagus* 4) *Calotropis*

213. The plant of this group are adopted to live partly in water and partly above substratum and free from water : **ORISSA-JEE-2008**
1) Xerophytes 2) Thallophytes
3) Halophytes 4) Hydrophytes

214. Cactaceae stores water in leaves, it implies : **ORISSA-JEE-2008**
1) Ephemerals 2) Drought resistants
3) Annuals 4) Non-succulents

215. Sunken stomata are found in : **ORISSA-JEE-2008**
1) Xerophytes 2) Hydrophytes
3) Mesophytes 4) Halophytes

216. Pneumatophores are characteristics of : **ORISSA-JEE-2008**
1) Halopytes 2) Xerophytes
3) Hydrophytes 4) None of these

217. Which is not an adaptive feature in plants growing in physiologically dry soil ? **ORISSA-JEE-2008**
1) Pneumatophores 2) Vivipary
3) Sunken stomata
4) Conductive tissue rudimentary

218. Sucking roots are present in the plant : **PB-PMT-2008**
1) *Betel* 2) *Cuscuta*
3) *Mangifera* 4) *Solanum*

219. Insectivorous plants live in a soil deficit in : **PB-PMT-2008**
1) Nitrate 2) Chloride
3) Potassium 4) Magnesium

220. Sunken stomata are found in : **BV-PUNE-2008**
1) *Nerium* 2) *Hydrilla*
3) Mango 4) None of these

221. Velamen tissue is found in : **BHU-2008**
1) Mesophytes 2) Epiphytes
3) Hydrophytes 4) Xerophytes

222. Cuticle is absent in : **DPMT-2009**
1) Mesophytes 2) Xerophytes
3) Young seedlings 4) Mature stem

223. Halophytes are grown in : **AFMC-2009**
1) Salty soils or saline water 2) Near the rivers
3) Deserts 4) Rainy water

224. Roots cap is absent in : **AFMC-2009**
1) Mesophytes 2) Hydrophytes
3) Xerophytes 4) Epiphytes

225. Reduction in vascular tissue, mechanical tissue and cuticle is characterstics of : **CBSE-2009**
1) Hydrophytes 2) Xerophytes
3) Epiphytes 4) Mesophytes

226. Insectivorous plants are usually adapted to :
1) Water rich soil **AFMC-2009**
2) Soil deficit in nitrogen
3) Soil rich in trace elements
4) Soil deficit in sugars

227. Ephemerals are drought : **ORISSA-JEE-2009**
1) Loving plants 2) Enduring plants
3) Escaping plants 4) Resistant plants

228. Xerophytes are mostly : **AFMC-2009**
1) Secculents 2) Water related
3) Mesophytes 4) None of these

229. Pneumatophores are characteristics of : **ORISSA-JEE-2009**
1) Mesophytes 2) Halophytes
3) Sciophytes 4) Heliophytes

230. Epiphytes are plants which depend on other plants for : **BHU-2010**
1) Food 2) Mechanical support
3) Shade 4) Water

231. Pneumatophores are seen in : **BHU-2010**
1) *Hydrilla* 2) *Typha*
3) *Rhizophora* 4) Both (1) and (2)

232. *Hydrilla* and *Vallisneria* are classical example of :
1) Marshy plants **CPMT-2010**
2) Angiospermic submerged plants
3) Free-floating plants
4) Attached emergent plants

233. Green leaf aerial stem or branches with a single intermode is called : **AMU-2010**
1) Bulbils 2) Cladodes
3) Phylloclade 4) Phyllode

234. Hydrophytes are characterised by : **ORISSA-JEE-2011**
1) Leaves reduced to spines
2) Well developed vascular tissues
3) Well developed mechanical tissues
4) Increase in aerenchyma

235. The features of the xerophytic plant leaves are :
1) Leathery surface **ORISSA-JEE-2011**
2) Large surface area
3) Waxy cuticle layer
4) Sunken stomata on upper surface

236. Lichens are pioneer vegetation on which succession? **BHU-2011**
1) Hydrosere 2) Halosere
3) Psammosere 4) Xerosere

237. Identify the plant belonging to reed swamp stage in hydrach succession : **BHU-2011**
1) Juncus 2) Sagittaria
3) Salix 4) Trapa

238. Which are the first organism to colonize on a barren rock? **CPMT-2011**
1) Fungi 2) Lichens
3) Diatoms 4) Mosses

239. The geographical limits within which a population exists is : **BV-PMT2011**
1) Niche 2) Ecosystem
3) Biomes 4) Habitat

240. The stable community in ecological succession is :
1) Pioneer 2) Sere **AFMC-2011**
3) Climax 4) Carnivores

241. Niche is defined as the : **DPMT-2011**
1) Position of species in a community in relation to other species
2) Place where organism lives
3) Place where organism is living and performing its duties
4) Place where population perform their duties

242. Which one of the following has maximum genetic diversity in india? **BHU-2010**
1) Tea 2) Teak
3) Mango 4) Wheat

243. A progressive series of changes in plant and animal life of an area from initial colonization is known as : **BV-PUNE-2008**
1) Evolution 2) Succession
3) Speciation 4) Selection

244. An association between two individuals or population where both are benefitted and neither can survive without the other is : **CBSE-2007**
1) Commensalism 2) Amensalism
3) Proto-cooperation 4) Mutualism

245. In primary succession on rocks, the pioneer species are usually : **CBSE-2008**
1) Algae 2) Fungi
3) Lichens 4) Bryophytes

246. Alpine tundra is found in : **CBSE-2009**
1) Siberia 2) Green land
3) Both (1) and (2) 4) Himalayas

247. Select the correct match : **CBSE-2010**
A. Sedimentary nutrients :Nitrogen cycle
B. Pioneer species : Lichens
C. Secondary succession : Burned forest
D. Pyramid of biomass in sea : Upright
1) A, B and D only
2) A and C only
3) B and C only
4) B and D only
e) A, B and C only

248. Which one of the following statements are correct for secondary succession? **CBSE-2011**
1) It is similar to primary succession
2) It begins on a barren rock
3) It occurs as deforested site
4) It follows primary succession

KEY

MODEL TEST - I

1) 3	2) 1	3) 4	4) 1	5) 2
6) 1	7) 4	8) 2	9) 1	10) 1
11) 4	12) 3	13) 3	14) 3	15) 1

MODEL TEST - II

16) 1	17) 3	18) 2	19) 1	20) 1
21) 2	22) 3	23) 3	24) 3	25) 2
26) 3	27) 3	28) 4	29) 1	30) 2

QUESTION BANK

TYPE - I

31) 2	32) 3	33) 2	34) 1	35) 4
36) 1	37) 2	38) 1	39) 4	40) 2
41) 1	42) 1	43) 4	44) 3	45) 3
46) 3	47) 2	48) 2	49) 1	50) 2
51) 2	52) 1	53) 1	54) 2	55) 4
56) 4	57) 1	58) 2	59) 1	60) 2
61) 1	62) 2	63) 3	64) 3	65) 4
66) 2	67) 3	68) 4	69) 1	70) 2
71) 3	72) 4	73) 2	74) 3	75) 2
76) 4	77) 3	78) 3	79) 2	80) 3
81) 4	82) 2	83) 4	84) 1	85) 3
86) 2	87) 3	88) 3	89) 1	90) 3
91) 1	92) 2	93) 2	94) 1	95) 1
96) 1	97) 4	98) 3	99) 2	100) 1
101) 1	102) 2	103) 4	104) 3	105) 3
106) 1	107) 2	108) 3	109) 1	110) 3
111) 4	112) 3	113) 4	114) 1	115) 1
116) 2	117) 3	118) 2	119) 2	120) 1
121) 3	122) 1	123) 3	124) 4	125) 2
126) 4	127) 1	128) 4	129) 3	130) 4
131) 3	132) 3	133) 4	134) 3	135) 4
136) 4	137) 2	138) 4	139)2	140)3
141)1	142)4	143)3	144)1	145)4
146)4	147)3	148)3	149)2	150)2
151)1	152)1	153)2	154)2	155)2
156)3	157)4	158)2	159)1	160)3
161)3	162)1	163)3	164)2	165)3
166)3	167)1	168)2	169)3	

TYPE - II

170)4	171)4	172)2	173)3	174)4
175)1	176)4	177)4	178)1	179)2
180)4	181)4	182)2	183)3	184)2
185)1	186)1	187)1		

TYPE - III

188)1	189)3	190)2	191)3	192)2
193)3	194)3	195)2	196)3	197)3
198)1				

TYPE - IV

199)3	200)4	201)3

TYPE - V

202)2	203)2	204)2	205)3	206)2
207)2	208)1	209)4	210)4	211)4
212)3	213)3	214)2	215)1	216)1
217)4	218)2	219)1	220)1	221)2
222)3	223)1	224)2	225)1	226)2
227)3	228)1	229)2	230)2	231)3
232)2	233)2	234)4	235)3	236)4
237)2	238)2	239)4	240)3	241)1
242)4	243)2	244)4	245)3	246)3
247)3	248)3			