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RATNESH SINGH

CISCE BOARD SPECIMEN QUESTION PAPER 2021-22 (Fully Solved) released on 25 AUGUST 2021

ICSE MCQs CHAPTERWISE QUESTION BANK CLASS 10

Biology

Strictly as per the Latest CISCE Reduced & Bifurcated Syllabus (Aug 6, 2021)

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Multiple Choice Questions with Explanations

- Mind Maps
- Revision Notes
- Mnemonics

Includes dynamic QR Code for all updates in the Academic Year 2021-22

Includes all Typologies of Questions as per CISCE Specimen Paper released on 25/08/2021

RATNESH SINGH

ICSE SEMESTER 1 EXAMINATION

SPECIMEN QUESTION PAPER
BIOLOGY

SCIENCE PAPER - 3

Maximum Marks: 40
Time allowed: One hour (inclusive of reading time)
ALL QUESTIONS ARE COMPULSORY.
The marks intended for questions are given in brackets [ ].

Select the correct option for each of the following questions.

SECTION I (15 Marks)

Q.1. Name the following by choosing the correct option: **[5]**

(a) A pair of corresponding chromosomes of the same shape and size but one from each parent.

1. Autosomes
2. Sex chromosomes
3. Homologous chromosomes
4. Analogous chromosomes

(b) The factor that does not affect the rate of transpiration.

1. Intensity of light
2. Velocity of wind
3. Carbon dioxide
4. Oxygen

(c) Movement of molecules of a substance from their higher concentration to lower concentration when they are in direct contact.

1. Diffusion
2. Endosmosis
3. Imbibition
4. Active transport

(d) The complex molecule consisting of a DNA strand and a core of histones.

1. Centrosome
2. Nucleotide
3. Nucleosome
4. Chromosome

(e) The solvent used to dissolve the chlorophyll pigment while testing a leaf for starch.

1. Soda lime
2. Carbolic acid
3. Methylated spirit
4. Water

Q.2. Complete the following statements by choosing the appropriate option for each blank: **[5]**

(a) During Meiosis _____ daughter cells are formed.

1. 4
2. 2
3. 8
4. 6

(b) Wooden doors swell up during the rainy season due to _____.

1. Osmosis
2. Diffusion
3. Imbibition
4. Transpiration

(c) The semi permeable membrane in a plant cell is the _____.

1. Cell wall
2. Cell membrane
3. Tonoplast
4. None of the above

(d) Guttation takes place through_____.

1. Stomata
2. Lenticels
3. Cuticle
4. Hydathodes

(e) A plant with variegated leaves is _____.

1. Coleus
2. Lotus
3. Peepal
4. Mango

Q.3. Choose the correct answer from each of the four options given below: [5]

(a) The pressure exerted by the cell contents on the cell wall:

1. Turgor pressure
2. Partial pressure
3. Wall pressure
4. Osmotic pressure

(b) The cell component visible only during cell division:

1. Chromosome
2. Chromoplast
3. Chromatin
4. Centriole

(c) Marine fish when placed under tap water bursts, because of:

1. Endosmosis
2. Exosmosis
3. Diffusion
4. Plasmolysis

(d) The sites of dark reaction of photosynthesis:

1. Grana
2. Fret
3. Stroma
4. Stoma

(e) The alternative forms of the same gene occupying the same position on homologous chromosomes:

1. Chromatids
2. Alleles
3. Autosomes
4. Centromere

SECTION II (15 Marks)

Q. 4. Explain the following terms: [5]

(a) Osmosis

1. Movement of water from their lower concentration to their higher concentration through a semi permeable membrane.
2. Movement of solutes from their lower concentration to their higher concentration through a semi permeable membrane.
3. Movement of water from their higher concentration to their lower concentration through a semi permeable membrane.
4. Movement of water from their higher concentration to their lower concentration through a freely permeable membrane.

(b) Photolysis

1. Splitting of water molecules into hydrogen ions and oxygen in the presence of light in grana.
2. Splitting of water molecules into hydrogen ions and oxygen in the presence of light in the stroma.
3. Splitting of water molecules into hydrogen ions and oxygen in the absence of light in grana.
4. Splitting of water molecules into hydrogen ions and oxygen in the absent of light in stoma.

(c) Law of segregation

1. The two members of a pair of factors join during the formation of gametes.
2. The two members of a pair of factors separate during the formation of gametes.
3. The two chromosomes of a pair of factors separate during the formation of gametes.
4. The two members of a pair of factors separate during the process of germination.

(d) Guttation

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1. The loss of water in the form of water droplets from the surface of the leaf.
2. The loss of water in the form of water droplets through the stomata.
3. The loss of water in the form of water vapour along the leaf margin.
4. The loss of water in the form of water droplets along the leaf margin.

(e) Active transport

1. Passage of water from its lower to higher concentration through a cell membrane without any expenditure of energy.
2. Passage of ions from its lower to higher concentration through a cell membrane without any expenditure of energy.
3. Passage of water from its lower to higher concentration through a cell membrane using energy from the cell.
4. Passage of ions from its lower to higher concentration through a cell membrane using energy from the cell.

Q.5. State the exact location of the following: [5]

(a) Spindle fibres

1. Between the two centrioles
2. Between the two centrosomes
3. Between chromatid and centromere
4. Between two centromeres

(b) Root hair

1. Extension of the cortex
2. Extension of epithelium
3. Extension of epidermis
4. Extension of endodermis

(c) Stomata

1. More the upper surface of dorsi ventral leaves
2. More on the lower surface of the dorsi ventral leaves
3. Both upper and lower surface of the dorsi ventral leaves
4. None of the above.

(d) Thylakoids

1. In the inner membrane of the chloroplast
2. Wall of the chloroplast
3. In the chlorophyll
4. In the stroma of the chloroplast

(e) Palisade parenchyma

1. Between the upper and lower epidermis of dicot leaves.
2. Between the upper epidermis and spongy parenchyma of dicot leaves.
3. Between the lower epidermis and spongy parenchyma of dicot leaves.
4. Between the upper and lower epidermis of monocot leaves.

Q.6. State the function of the following: [5]

(a) Stroma

1. Site of photolysis of photosynthesis
2. Site of photochemical phase of photosynthesis
3. Site of light dependent phase of photosynthesis
4. Site of light independent phase of photosynthesis

(b) Guard cells

1. Regulate the closing of stomata
2. Regulate the opening and closing of stomata
3. Regulate the opening of stomata
4. Regulate the process of photosynthesis

(c) Xylem

1. Translocation of food from the leaves to the other parts of the plant.
2. Conduction of food.
3. Conduction of water and food.
4. Conduction of water and minerals from the root to the other parts of the plant.

(d) Chromosomes

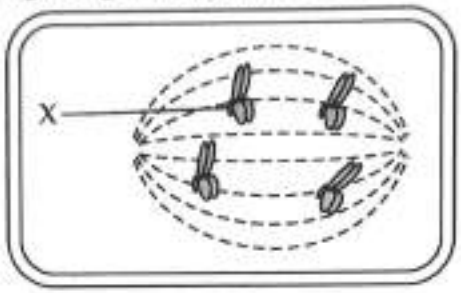
1. The carriers of heredity
2. The controlling centre of the cell
3. The site for various chemical reactions
4. Intracellular digestion.

(e) Hydathode

1. Helps in transpiration
2. Helps in guttation
3. Helps in imbibition
4. Helps in transportation of water

SECTION III (10 Marks)

Q.7. Given below is a diagram representing a stage during mitotic cell division. Answer the questions that follow [5]



(a) Identify the stage

1. Telophase
2. Prophase
3. Metaphase
4. Anaphase

(b) Label part marked 'X'

1. Centriole
2. Centrosome
3. Centromere
4. Chromatid

(c) Name the stage that follows the one shown here

1. Interphase
2. Anaphase
3. Telophase
4. Metaphase

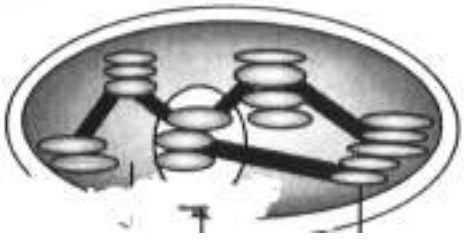
(d) What is the diploid number of chromosomes shown in the diagram?

1. 6
2. 2
3. 4
4. 8

(e) Mention one important feature of this stage

1. Nucleolus reappears
2. Nuclear membrane reappears
3. Nuclear membrane disappears
4. Chromosomes align on the equator

Q.8. Observe the diagram given below and answer the questions



SPECIMEN QUESTION PAPER

(a) Identify the cell organelle

1. Mitochondria
2. Lysosome
3. Ribosome
4. Chloroplast

(b) Label the parts marked A, B & C

A.	1. Granum	2. Stroma	3. Fret	4. Thylakoid
B.	1. Granum	2. Stroma	3. Fret	4. Thylakoid
C.	1. Granum	2. Stroma	3. Fret	4. Thylakoid

(c) The unit of light absorbed by chlorophyll is_____

1. Proton
2. Photon
3. Electron
4. Neutron

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SOLUTIONS

ECTION - I

ues-1

(a) Option 3 is correct.

Explanation: A pair of chromosomes of the same size and shape bearing corresponding genes governing the same set of traits. During crossing over the process of exchange of chromatids parts between the maternal and paternal chromatids of a pair of homologous chromosomes during meiosis.

(b) Option 4 is correct.

Explanation: Oxygen in general does not affect transpiration. It does not have direct impact on rate of transpiration.

(c) Option 2 is correct.

Explanation: Diffusion is the movement of molecules of a substance (gas, liquid or solid) from the region of higher concentration to the region of lower concentration.

(d) Option 3 is correct.

Explanation: A nucleosome is a section of DNA that is packed around a core of histone protein.

(e) Option 3 is correct.

Explanation: Methylated spirit is used to dissolve chlorophyll. Since chlorophyll is soluble in organic solvents like methanol, ethanol, the leaf is soaked in ethanol or methylated spirit to obtain chlorophyll.

ues-2

(a) Option 1 is correct.

Explanation: Meiosis is a reduction division in which number of chromosomes reduced to half in the daughter cell. Also meiosis takes place in two parts as Meiosis I & II. After two rounds of divisions, 4 haploid cells are formed.

(b) Option 3 is correct.

Explanation: In imbibition process, water is adsorbed to the surface of hydrophilic colloids. As wood has strong affinity for water, they absorb water from their surroundings and get swelled up.

(c) Option 2 is correct.

Explanation: The cell membrane of plant cell is semi permeable in nature . It allows only selected molecules to pass through it, and restrict the other materials.

d) Option 4 is correct.

Explanation: Guttation is the loss of water in the form of liquid drops. It usually occurs through specialized structure called hydathode due to root pressure.

e) Option 1 is correct.

Explanation: Coleus is a genus of annual or perennial herbs or shrubs, with variegated leaves.

Ques-3

(a) Option 1 is correct.

Explanation: Turgor Pressure in a turgid plant cell is the pressure exerted by the cell contents on the cell wall.

(b) Option 1 is correct.

Explanation: Chromosomes are visible only during the stages of cell division. In non dividing stage of cell, Chromosomes form coiling and supercoiling of chromatin fibres.

(c) Option 1 is correct.

Explanation: Endosmosis is the osmotic entry of water into a cell or system, when placed in pure water or hypotonic solution.

(d) Option 3 is correct.

Explanation: The dark phase occurs in the stroma of the chloroplast where the entire enzyme necessary for CO_2 fixation and synthesis of sugar and starch are located.

(e) Option 2 is correct.

Explanation: Alleles are various forms of a gene or Mendelian factor which occurs on the same locus on homologous chromosomes and control the same character. Alleles or allelomorphs control different expressions or traits of the same character (e.g., tallness and dwarfness in Pea).

SECTION - II

Ques-4

(a) Option 3 is correct.

Explanation: Osmosis is the movement of water from the region of higher chemical potential (dilute solution) to the region of its lower chemical potential (concentrated solution) when diffusion of solute is prevented by a semi permeable membrane.

(b) Option 1 is correct.

Explanation: Photolysis is a process of splitting of water molecule into hydrogen and oxygen in the presence of sunlight by activated photo-synthetic pigments.

(c) Option 3 is correct.

Explanation: Law of segregation states that the two contrasting factors do not mix in the F1 generation but segregate or separate from each other at the time of gamete formation.

(d) Option 4 is correct.

Explanation: Guttation is the loss of water in the form of liquid drops. It usually occurs through specialized structure called hydathode at leaf margin due to root pressure.

(e) Option 4 is correct.

Explanation: Active transport involves molecules moving against a gradient from an area of lower to higher concentration. It involves the expenditure of metabolic energy (ATP) released through respiration.

Ques-5

(a) Option 2 is correct.

Explanation: The chromosomes arrange themselves in the equator of the spindle to form the equatorial plate. Each chromosome is attached to the spindle fibres by its centromere.

(b) Option 3 is correct.

Explanation: Root hair also called as absorbent hairs, are tube like outgrowths of an epidermis of a root, a hair-forming cell on the epidermis of a plant root.

(c) Option 2 is correct.

Explanation: Stomata are mostly present on lower surface of the leaf in case of dorsiventral leaves.

(d) Option 4 is correct.

Explanation: Chloroplast contains a matrix or stroma in which the thylakoids are present. At some places the thylakoids are arranged themselves to form a stalk of coins like structure called grana.

(e) Option 2 is correct.

Explanation: The palisade parenchyma are present below the upper epidermis and composed of columnar cells oriented perpendicular to the leaf surface above the spongy parenchyma.

Ques-6

(a) Option 4 is correct.

Explanation: The dark phase occurs in the stroma of the chloroplast where all the enzyme necessary for CO_2 fixation and synthesis of sugar and starch are located.

(b) Option 2 is correct.

Explanation: Stomata open in light when guard cells are turgid and close when they are flaccid. Thus guard cell helps in opening and closing of stomata.

(c) Option 4 is correct.

Explanation: Upward transport of water to aerial parts along with the dissolved mineral salts from roots to the aerial parts against the downward pull of gravity is called ascent of sap. Ascent of sap takes place through xylem.

(d) Option 1 is correct.

Explanation: Chromosomes are rod-shaped or thread like deeply stainable condensed chromatin fibres which are hereditary vehicles. Role of chromosome in hereditary process was discovered by Morgan.

(e) Option 2 is correct.

Explanation: Guttation is the exudation of water from hydathodes present at vein endings.

SECTION - III

Ques-7

(a) Option 2 is correct.

Explanation: Prophase is the longest phase of division. Replicated chromosomes each with sister chromatids condense and become visible. Nuclear membrane along with nucleolus starts disappearing.

(b) Option 3 is correct.

Explanation: Each chromosome consists of 2 units or arms, called chromatids attached at a point called primary constriction or centromere.

(c) Option 4 is correct.

Explanation: The stages of cell division are- Prophase, Metaphase, Anaphase and Telophase. Prophase is immediately followed by metaphase.

(d) Option 3 is correct.

Explanation: Mitosis results in the formation of identical cells. Daughter cells have same genetic constitution quantitatively and qualitatively as the original cell. Thus, the diploid number of chromosome will be 4 only.

(e) Option 3 is correct

Explanation: Nuclear membranes along with nucleolus start disappearing in prophase.

Ques-8

(a) Option 4 is correct.

Explanation: A chloroplast is an oval, minute, double membrane organelle present in green plants. Internally, it contains a matrix or stroma and the thylakoids. At some places the thylakoids are arranged themselves to form a stalk of coins like structure called grana.

(b)A. Option 2 is correct.

Explanation: In chloroplast, dark reaction takes place in stroma.

(b)B. Option 1 is correct.

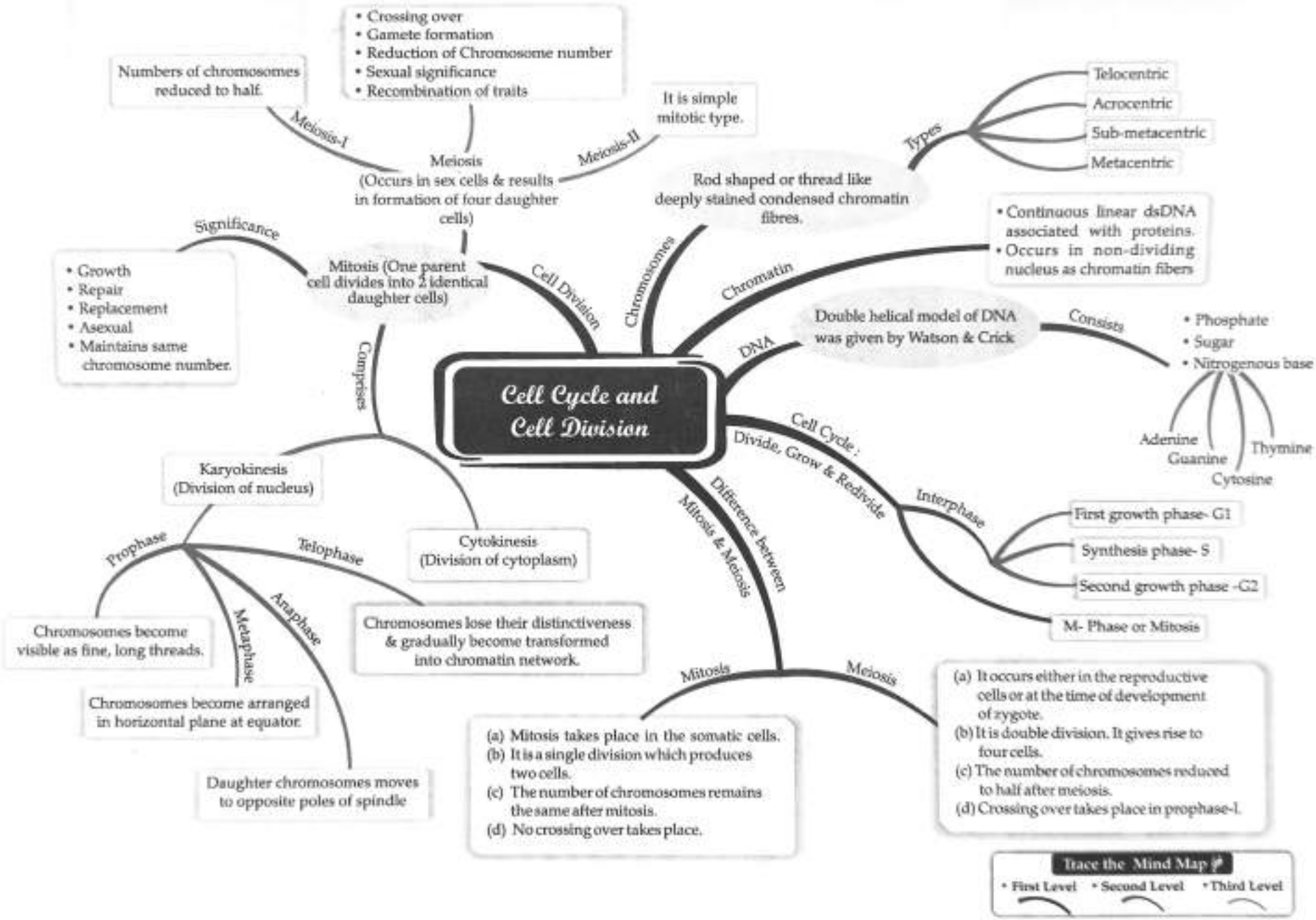
Explanation: Granum is the stack of thylakoid, where light reaction takes place.

(b)C. Option 4 is correct.

Explanation: Thylakoid is the unit of chloroplast as coin like structure where light reaction takes place.

(c) Option 2 is correct.

Explanation: Photons of sunlight are absorbed by the chlorophyll molecule. Photophosphorylation is the process in which ADP (Adenosine Diphosphate) is converted into ATP (Adenosine Triphosphate) by the addition of one phosphate (Pi) group, i.e inorganic phosphate, utilizing the energy from photons.


Cell Cycle and Cell Division
Cell Division
Mitosis (One parent cell divides into 2 identical daughter cells)
Significance
• Growth
• Repair
• Replacement
• Asexual
• Maintains same chromosome number.
Meiosis (Occurs in sex cells & results in formation of four daughter cells)
Meiosis-I
Numbers of chromosomes reduced to half.
• Crossing over
• Gamete formation
• Reduction of Chromosome number
• Sexual significance
• Recombination of traits
Meiosis-II
It is simple mitotic type.
Chromosomes
Rod shaped or thread like deeply stained condensed chromatin fibres.
Types
Telocentric
Acrocentric
Sub-metacentric
Metacentric
Chromatin
• Continuous linear dsDNA associated with proteins.
• Occurs in non-dividing nucleus as chromatin fibers
DNA
Double helical model of DNA was given by Watson & Crick
Consists
• Phosphate
• Sugar
• Nitrogenous base
Adenine
Guanine
Thymine
Cytosine
Cell Cycle : Divide, Grow & Redivide
Interphase
First growth phase- G1
Synthesis phase- S
Second growth phase -G2
M- Phase or Mitosis
Difference between Mitosis & Meiosis
Mitosis
(a) Mitosis takes place in the somatic cells.
(b) It is a single division which produces two cells.
(c) The number of chromosomes remains the same after mitosis.
(d) No crossing over takes place.
Meiosis
(a) It occurs either in the reproductive cells or at the time of development of zygote.
(b) It is double division. It gives rise to four cells.
(c) The number of chromosomes reduced to half after meiosis.
(d) Crossing over takes place in prophase-I.
Complexes
Karyokinesis (Division of nucleus)
Cytokinesis (Division of cytoplasm)
Prophase
Chromosomes become visible as fine, long threads.
Metaphase
Chromosomes become arranged in horizontal plane at equator.
Anaphase
Daughter chromosomes moves to opposite poles of spindle
Telophase
Chromosomes lose their distinctiveness & gradually become transformed into chromatin network.
Trace the Mind Map
• First Level • Second Level • Third Level

CHAPTER 1

CELL CYCLE AND CELL DIVISION

Syllabus

- *Cell Cycle and Cell Division.*
- *Structure of chromosome.*

REVISION NOTES

Cell Cycle and Cell Division

- All living beings are made up of one or more units called cells.
- The organisms made up of a single cell are called **unicellular organisms** while the organisms that consists of many cells are known as **multicellular organisms.**
- The study of cell is called **Cytology.** The term cell was given by Robert Hooke for the first time when he observed cork cells under a primitive microscope assembled by him.
- **Cell Theory:** The credit of formulation of cell theory is given to a German Botanist M.J. Schleiden and a German Zoologist T. Schwann who clearly outlined the basic features of cell theory that includes
  (a) All living organisms are made up of cells.
  (b) Cells always arise from the pre-existing living cells by division.
- Growth is a continuous process which occurs throughout the life of cell.
- Each and every cell in an organisms posses three essential part – cell membrane, cytoplasm and nucleus.

Scan to know more about this topic

Cell Division

- **Cell division**
  - It is necessary for proper growth, development and survival of organisms.
- **Cell cycle**
  - It is the sequence of events including growth and division, that cell undergoes from the time of its formation up to its division into daughter cells.
  - Cell cycle comprises of two phases – interphase and phase of division (mitosis and meiosis i.e. M Phase)
  - G_1, S, G_2 and M – phase collectively form the cell cycle.

Scan to know more about this topic

Cell Cycle

- **Interphase**
  - It is a series of changes that takes place in a newly formed cell and in its nucleus before it becomes capable of dividing again. Therefore, it is also called intermitosis.
  - Interphase of dividing cell has three stages - G_1 , S and G_2.
  - It is also known as biosynthetic phase in which cell duplicates its cell organelles and replicates its DNA.
  - **G_1 phase** is characterized by the synthesis of RNA and non-histone proteins. Cell growth occurs and substances are produced which inhibit or stimulate the onset of next S – phase.
  - **S phase** follows the G_1 - phase. It is characterized by the replication of DNA and the chromosome are completely duplicated.

- **G_2 - phase** is the period in which centrioles, mitochondria, golgi bodies and other cytoplasmic organelles are doubled.

➢ **M or D phase**
- It is the phase when the cell enters the prophase stage of cell division.

➢ **Phase of Division-Mitosis**
- Mitotic (M – phase) consists of karyokinesis (division of nucleus) and cytokinesis (division of cytoplasm).
- **Mitosis** results in the formation of identical cells. Daughter cells have same genetic constitution quantitatively and qualitatively as the original cell.
- Mitosis was first observed by Strasburger in plant cells and by Flemming in animal cells.

➢ **Karyokinesis**
- **Karyokinesis:** It comprises of four phases – prophase, metaphase, anaphase and telophase.
- **Prophase:** It is the longest phase of division. Replicated chromosomes each with sister chromatids condense and become visible. Nuclear membrane along with nucleolus disappear.
- **Metaphase:** The chromosomes arrange themselves in the equator of the spindle to form the equatorial plate. Each chromosome is attached to the spindle fibres by its centromere.
- **Anaphase:** The centromere split and the newly-copied chromosomes (daughter chromatids) are moved to opposite poles of the cell.
- **Telophase:** It is the phase in which nuclear membrane is reformed around each group of chromatids, now called chromosomes at each pole. *Two nuclei are thus formed.*

➢ **Importance of Mitosis**
- Karyokinesis is followed by cytokinesis in which cytoplasm of the cell divides in two parts.
- It brings about the reproduction in unicellular organisms.
- It is necessary for growth, maintenance and repair in multicellular organisms.

➢ **Differences between animal and plant cell mitosis**

Mitosis in Animal cell	Mitosis in Plant cell
1. Aster are formed.	1. Asters are not formed.
2. Cytokinesis occurs by furrowing of cytoplasm.	2. Cytokinesis occurs by cell plate formation.
3. Occurs in most tissues throughout the body.	3. Occurs mainly at the growing tips and sides.

➢ **Meiosis**
- **Meiosis** is the cell division which occurs in sex cells and results in the formation of four daughter cells. The daughter cells are quantitatively and qualitatively different from mother cells.
- The whole process consists of two successive coordinated divisions called meiosis – I and meiosis – II.
- During meiosis – I, the number of chromosomes reduced to half while in meiosis – II, division is the simple mitotic type.
- Meiosis maintains the same chromosome number through successive generation of species.
- The most important significance of meiosis is that the number of chromosomes in the sex cells are halved.
- It helps to produce the new recombination of characters as a result of crossing over (exchange of genetic material between two homologous chromosome).

➢ **Major differences between Mitosis and Meiosis are**

Mitosis	Meiosis
(a) Mitosis takes place in the somatic cells.	(a) It occurs either in the reproductive cells or at the time of development of zygote.
(b) It is a single division which produces two cells.	(b) It is a double division. It gives rise to four cells.
(c) The number of chromosomes remains the same after mitosis.	(c) The number of chromosomes get reduced to half after meiosis.
(d) No crossing over takes place.	(d) Crossing over takes place in prophase - I.

Structure of Chromosome

➢ Chromosomes are rod-shaped or thread like deeply stainable condensed chromatin fibres which are hereditary vehicles.

➢ Hofmeister(1848) first observed the chromosome. The name chromosome was proposed by W. Waldeyer (1888).

➢ **Role of Chromosome**
- Role of chromosome in hereditary process was discovered by Morgan (1933).
- A set of paired chromosomes or two sets of chromosomes is known as diploid, e.g. Human – 23 Chromosomes.
- A set of unpaired chromosome or a single set of chromosome is said to be a haploid.

➢ **Types of Chromosome**
- Each chromosome consists of 2 units or arms, called chromatids attached at a point called primary constriction or centromere.
- **Centromere:** Depending on the location of centromere, chromosomes are classified into four types –
  (i) **Telocentric:** Centromere at one tip.
  (ii) **Acrocentric:** Centromere is just below the tip.
  (iii) **Sub-metacentric:** Centromere is in between the center and tip of the chromosome.
  (iv) **Metacentric:** Centromere is in the middle.
- **Chromatin fibre:** A chromatin fibre is a continuous linear DNA double strand associated with proteins of two types – basic histones and acid or neutral non-histones.
- It also contains some RNA and some enzymes such as DNA and RNA polymerases.
- The term chromatin means "coloured material." The chromatin occurs in a non-dividing nucleus as fine filaments termed as the chromatin fibres.
- A chromosome consists of two identical halves called chromatids that are held together at one point i.e. the centromere.
- Double helical model to explain the structure of DNA was given by Watson & Crick in 1953.
- The organisms which contain a segment of foreign DNA or gene are known as transgenic organisms.

Scan to know more about this topic
Structure of Chromosome

MNEMONICS

(i) Cell Cycle Stages Call
Get Set Go! Make a call
Call G: G_1 Phase
S: S Phase
G: G_2 Phase
M: M Phase
C: Cytokinesis

Mitotic Stages
I Prefer Milk and Tea-Cofee
I: Interpahse
P: Prophase
M: Metaphase
A: Anaphase
T: Telophase
C: Cytokinesis

Nucleotide Base Pairs
Apple on Tree, Car in Garage
Adenine, Thymine, Cytosine, Guanine

KNOW THE TERMS

- **Amitosis:** Cell divides without spindle formation.
- **Disjunction:** It is the separation of homologous chromosomes during cell division.
- **Non-disjunction:** It is the non-separation of homologous chromosomes during anaphase – I of meiosis – I.
- **Congression:** Chromosome fibres contract and bring the chromosome over the equator.
- **Mitogens:** The agents which stimulate the cell division are called mitogens. e.g. Cytokinins and some steroids.
- **Mitotic poisons:** There are some chemicals which inhibit cell division e.g. azides, cyanides, colchicine.
- **Intranuclear mitosis and pre-mitosis:** In protists, fungi and algae, the nuclear envelop does not degenerate during mitosis, instead spindle is formed inside the nucleus.
- **Centromeric Index:** It is the ratio of lengths of the two arms of chromosome.
- **Allosomes:** These are sex chromosomes whose presence, absence and particular form determines the sex of the individual.
- **Autosomes:** Chromosomes other than sex chromosomes are called autosomes.
- **Homogametic:** Individuals having homomorphic sex chromosomes produce similar gametes. e.g. Human female

- **Heterogametic:** Individuals with heteromorphic sex chromosome produce two types of gametes. e.g. Human male.
- **Karyotype:** Karyotype is a chromosome complement of a cell / organism providing description of various aspects of all the chromosomes like number, relative size, position of centromere, length of arms and satellite.
- **Satellite / Trabant:** A satellite chromosome or SAT chromosome has a chromosome segment that is separated from the main body of the chromosome by a secondary constriction.

MULTIPLE CHOICE QUESTIONS

STAND ALONE MCQs

Q. 1. Cell cycle

(A) The sequence of events including growth and divisions, from the time of its formation up to its division into daughter cells.

(B) The sequence of events that cell undergoes in mitosis.

(C) The sequence of events that cell undergoes in meiosis.

(D) Sequence of events including growth and divisions, from the time of its formation up DNA multiplication.

Ans. Option (A) is correct.

Explanation: Cell cycle comprises of two phases – interphase (G1, S, G2) and phase of division (mitosis and meiosis i.e. M Phase). These G1, S, G2 and M – phase collectively form the cell cycle.

Q. 2. Disjunction

(A) It is the separation of homologous chromosomes during cell morphogenesis.

(B) It is the separation of homologous chromosomes during resting phase.

(C) It is the separation of homologous chromosomes during cell division.

(D) It is the separation of homologous chromosomes during DNA synthesis.

Ans. Option (C) is correct.

Explanation: The separation or moving apart of chromosomes on separate poles of the cell during cell division is known as disjunction.

Q. 3. Nucleotides

(A) The repeating component of carbohydrate.

(B) The repeating component of each DNA strand lengthwise.

(C) Then on repeating component of each DNA strand lengthwise.

(D) The repeating component of protein.

Ans. Option (B) is correct.

Explanation: Nucleotide is the basic building block of nucleic acids. RNA and DNA are polymers made of long chains of repeating units of nucleotides.

Q. 4. Cytokinesis

(A) The division of nucleus.

(B) The division of cytoplasm that occurs before division of nucleus.

(C) The division of cytoplasm that occurs after division of nucleus.

(D) The division of cell that occurs after division of nucleus.

Ans. Option (C) is correct.

Explanation: It is the division of cytoplasm that takes place soon after karyokinesis or division of nucleus.

State the exact location of the following:

Q. 1. DNA

(A) Nucleus

(B) Rough endoplasmic reticulum

(C) Nuclear Membrane

(D) Ribosomes

Ans. Option (A) is correct.

Explanation: Mostly DNA is located in the cell nucleus and it is called nuclear DNA, but a small amount of DNA can also be found in the mitochondria.

Q. 2. Centromere

(A) At different positions on the chromosome.

(B) On the centre of chromosome.

(C) At terminal positions on the chromosome.

(D) Anywhere inside nucleus.

Ans. Option (A) is correct.

Explanation: Chromosome consists of 2 units or arms, called chromatids attached at a point called primary constriction or centromere. Centromeres are typically located in the central area of a chromosome but they can also be located at a number of different positions on the chromosome.

Q. 3. Histone protein

(A) In association with RNA

(B) In association with other cytoplasmic protein

(C) In association with nucleoplasm

(D) In association with DNA

Ans. Option (D) is correct.

Explanation: Chromatin fibre contains linear DNA double strand associated with proteins of two types – basic histones and acid or neutral non-histones.

Q. 4. Spindle fibres

(A) Attached with chromosome
(B) Attached with DNA strand
(C) Attached with nuclear membrane
(D) Attached with cell plate

Ans. Option (A) is correct.

Explanation: The chromosomes arrange themselves in the equator of the spindle to form the equatorial plate. Each chromosome is attached to the spindle fibres by its centromere.

State the function of the following

Q. 1. Centrosome

(A) To initiate cell division
(B) To initiate cell wall formation
(C) To initiate crossing over
(D) To initiate cell degeneration.

Ans. Option (A) is correct.

Explanation: The specific function of the centrosome found in the cells of animals is to initiate cell division.

Q. 2. Mitogens

(A) Stimulate the cell enlargement.
(B) Stimulate the cell mutation
(C) Stimulate the cell division
(D) Stimulate the cell cycle

Ans. Option (C) is correct.

Explanation: The agents which stimulate the cell division are called mitogens. e.g. Cytokinins and some steroids.

Q. 3. Cell plate

(A) Formation of cell wall
(B) Formation of nucleus
(C) Formation of cell membrane
(D) Formation of nuclear membrane.

Ans. Option (A) is correct.

Explanation: In plant cells, formation of cell plate takes place at the equatorial plane of the spindle. It involved in the formation of cell wall between the two daughter cells following cell division.

Q. 4. Meiosis

(A) Cell division
(B) Production of gametes
(C) Formation of gene pool
(D) DNA synthesis.

Ans. Option (B) is correct.

Explanation: Meiosis is the cell division which occurs in sex cells and results in the formation of four daughter cells. The main function of the meiotic division is the production of gametes (egg cells or sperm cells) or spores.

Q. 5. After, mitotic cell division, a female human cell will have:

(A) 44 +XX chromosome
(B) 44 + XY chromosome
(C) 22 + X chromosome
(D) 22 + Y chromosome

Ans. Option (A) is correct.

Explanation: In mitotic division, there is no change in number of chromosomes the cell. It maintains the exact number of chromosomes in the daughter cells.

Q. 6. Synthesis phase in the cell cycle is called so, because of the synthesis of more:

(A) RNA.
(B) RNA and proteins
(C) DNA
(D) Glucose

Ans. Option (C) is correct.

Explanation: S-phase or synthesis phase of cell cycle occurs before mitotic phase. In this phase DNA synthesis takes place and cell prepares for mitosis.

Q. 7. The cell component visible only during cell division is:

(A) Mitochondria
(B) Chloroplast
(C) Chromosome
(D) Chromatin

Ans. Option (C) is correct.

Explanation: In mammalian cells, the organelles don't really "disappear" during mitosis. But they actually get dispersed/fragmented and during cytokinesis segregate into the two daughter cells.

Q.8. The number of daughter cells formed at the end of meiosis from a cell are:

(A) 2 haploid cells
(B) 2 diploid cells
(C) 4 haploid cells
(D) 4 diploid cells

Ans. Option (C) is correct.

Explanation: During meiosis, four daughter cells are produced, each of which are haploid (containing half as many chromosomes as the parent cell).

Q. 9. Chromosomes become visible as fine, long threads in:

(A) Metaphase
(B) Prophase
(C) Telophase
(D) Interphase

Ans. Option (B) is correct.

Explanation: In prophase, the condensation of chromatin begins and the chromosomes become visible.

Q. 10. Name the type of cell division that occurs during formation of pollen grain.

(A) Meiosis (B) Mitosis
(C) Both of these (D) None of these

Ans. Option (A) is correct.

Explanation: Pollen grains are reproductive structure of plants. Pollens contain sperms which has sex chromosomes. Thus, meiosis occurs during formation of pollen grains.

AI Q. 11. Histone proteins are associated with

(A) DNA (B) RNA
(C) cell wall (D) cell membrane

Ans. Option (A) is correct.

Explanation: Histones are basic proteins that associate with DNA in the nucleus and help to condense it into chromatin. DNA and histones are packed together to be nucleosome, the nucleosome forms a pack called the chromatin, and two chromatin form a chromosome.

Q. 12. The repeating component of each DNA strand lengthwise is

(A) Adenine (B) pyrimidine
(C) nucleotide (D) nucleoside

Ans. Option (B) is correct.

Explanation: The repeating components of each dna strand lengthwise is called the nucleotide. Each nucleotide has phosphate and a pentose group attached lengthwise and a nitrogenous base that is attached to the sugar.

Q. 13. Name a membrane that disappears in late prophase.

(A) Nuclear membrane (B) Plasma Membrane
(C) Organelle membrane (D) None

Ans. Option (A) is correct.

Explanation: During the end of prophase and before the start of metaphase the nuclear membrane completely disappear.

Q. 14. Name the organelle which initiates the cell division in animal cell.

(A) Chromosome (B) Centrioles
(C) Golgi body (D) Mitochondria

Ans. Option (B) is correct.

Explanation: The cell organelle responsible for initiating cell division is the centriole.

Q. 15. Which bonds are present between the complementary nitrogenous base of DNA

(A) Nitrogen bond (B) Hydrogen bond
(C) Carbon bond (D) Oxygen bond

Ans. Option (B) is correct.

Explanation: Purine and pyrimidine complementary base pairing occur by forming hydrogen bonds between them.

AI Q. 16. Which of the following is not a part of Nucleotide?

(A) Phosphate (B) RNA
(C) Pentose sugar (D) Nitrogenous base

Ans. Option (B) is correct.

Explanation: Nucleotides are made up of Nitrogenous base, phosphate and sugar. RNA is not the part of Nucleotide.

Q. 17. Which of the following is Purine nitrogenous base of DNA molecule?

(A) Guanine (B) Cytosine
(C) Creatinine (D) Thymine

Ans. Option (A) is correct.

Explanation: Nitrogenous base purines are of two types Adenine and Guanine. Cytosine and Thymine are pyrimidine bases.

Q. 18. What is the technical term for the division of nucleus?

(A) Cytokinesis (B) Urokinesis
(C) Nucleokinesis (D) Karyokinesis

Ans. Option (D) is correct.

Explanation: Division of nucleus in the cell is called karyokinesis. Cytokinesis is the process of division of cytoplasm.

Q. 19. Name the state of cell division prior to anaphase.

(A) Metaphase (B) Telophase
(C) Interphase (D) Prophase

Ans. Option (A) is correct.

Explanation: Metaphase is the phase of mitosis that follows prophase and prometaphase and precedes anaphase.

ASSERTION AND REASON MCQs

Directions: In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both (A) and (R) are true, and (R) is the correct explanation of (A).
(B) Both (A) and (R) are true, but (R) is not the correct explanation of (A).
(C) (A) is true, but (R) is false.
(D) (A) is false, but (R) is true.

Q. 1. **Assertion (A):** Interphase is also known as resting phase.

Reason (R): Cell takes rest in interphase before entering the cell division process.

Ans. Option (C) is correct.

Explanation: In Interphase cell prepares itself for the process of mitosis that includes cell growth, replication of DNA etc. but no activity is observed related to nuclear division. Hence, it is called as resting phase.

Q. 2. **Assertion (A):** DNA synthesis takes place in G phase.

Reason (R): Chromosome duplication occurs during cell cycle.

Ans. Option (D) is correct.

Explanation: DNA synthesis and chromosome duplication takes place during S phase or synthesis phase of cell cycle.

Q. 3. **Assertion (A):** Mitosis does not lead to genetic recombination.

Reason (R): No crossing over takes place during mitosis.

Ans. Option (A) is correct.

Explanation: Recombination is a process by which pieces of DNA are broken and recombined to produce new combinations of alleles. Crossovers result in recombination and there is exchange of genetic material between the parental chromosomes. As a result of which the offspring will have a totally different combinations of genes unlike their parents. This happens in meiosis. Whereas in mitosis, recombination means repairing the double-stranded breaks or single-stranded gaps present in the chromosomes.

Q. 4. **Assertion (A):** In M phase karyokinesis takes place.

Reason (R): It is followed by cytokinesis.

Ans. Option (B) is correct.

Explanation: M phase or the Mitotic phase is a short phase wherein two important activities occur simultaneously. They are Karyokinesis wherein the division of the nucleus takes place and Cytokinesis, wherein the division of the cytoplasm takes place, thereby resulting in two daughter cells.

AI Q. 5. **Assertion (A):** Mitosis is called reduction division.

Reason (R): In reduction division, the chromosome number reduced from diploid to haploid.

Ans. Option (D) is correct.

Explanation: Reduction division takes place during meiosis I, during which chromosome number become half.

Q. 6. **Assertion (A):** During metaphase, chromosome has two chromatids.

Reason (R): Separation of sister chromatids takes place during anaphase.

Ans. Option (B) is correct.

Explanation: In the mitotic phase, each chromosome has two sister chromatids and these two sister chromatids are clearly visible during metaphase stage. DNA replication results in the formation of two identical copies of each chromosome, i.e., the sister chromatids, that are firmly attached at the centromere region.

After metaphase comes anaphase, during which each chromosome's sister chromatids separate and move to opposite poles of the cell.

Q. 7. **Assertion (A):** In plant cell, cell plate is formed during cytokinesis.

Reason (R): Cytokinesis is the division of cytoplasm of the cell.

Ans. Option (A) is correct.

Explanation: Cytokinesis occurs by cell plate formation. Cytokinesis is the process in which the cytoplasm of a single cell divides to form two daughter cells.

AI Q. 8. **Assertion (A):** Adenine pairs with guanine in double helical DNA structure.

Reason (R): Purine base is always paired with pyrimidine base.

Ans. Option (D) is correct.

Explanation: Adenine and guanine, both are purine bases. During base paring in DNA structure adenine pairs with thymine and guanine pairs with cytosine.

Q. 9. **Assertion (A):** Centrosome is the cell organelle that initiates the process of cell division.

Reason (R): Centrosome gets attached to the sister chromatids and helps in chromosome separation.

Ans. Option (C) is correct.

Explanation: Centrosome consists of two centrioles which are present at two poles of the cell. These centrioles form the spindle fibres which help in the process of cell division.

Q. 10. **Assertion (A):** Identical daughter cells are formed after mitosis.

Reason (R): No reduction division takes place in mitosis.

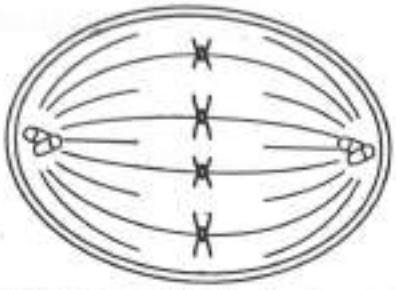
Ans. Option (B) is correct.

Explanation: In mitosis, no crossing over takes place so the cells formed after division are identical.

CASE-BASED MCQs

Picture Based Questions

I. Given below is the diagram of stage of cell division. Observe carefully and answer questions from Q1 to Q5.



Q. 1. Which stage of cell division is shown in diagram?

(A) Prophase (B) Metaphase
(C) Anaphase (D) Telophase

Ans. Option (B) is correct.

Explanation: In metaphase, Chromosomes are thick and short that are present at equatorial plate.

Q. 2. Name the stage that follows the one shown here

(A) Interphase (B) Anaphase
(C) Telophase (D) Metaphase

Ans. Option (C) is correct.

Explanation: In mitosis, sequence of division is prophase, metaphase, anaphase, telophase, cytokinesis. In Anaphase, two sister chromatids of each chromosome separate out from each other and start moving towards opposite poles.

Q. 3. Name the type of cell shown in diagram.

(A) Plant cell
(B) Animal cell
(C) Prokaryotic cell
(D) None of the above

Ans. Option (B) is correct.

Explanation: Presence of centrioles indicates that the cell is an animal cell.

Q. 4. Mention one important feature of this stage

(A) Chromosomes arrange themselves in the equator
(B) Chromosomes arrange themselves at poles.
(C) Chromosomes are seen as chromatin fibres
(D) Chromosomes arrange themselves two halves.

Ans. Option (A) is correct.

Explanation: In Metaphase, the chromosomes arrange themselves in the equator of the spindle to form the equatorial plate. Each chromosome is attached to the spindle fibres by its centromere.

Q. 5. Name the type of cell division that occurs during gamete formation.

(A) Mitosis (B) Meiosis
(C) Binary fission (D) Budding

Ans. Option (B) is correct.

Explanation: Meiosis is the cell division which occurs in sex cells and results in the formation of four daughter cells. The main function of the meiotic division is the production of gametes (egg cells or sperm cells) or spores.

AI **II. Given below is the diagram of stage of cell division. Observe carefully and answer questions from Q1 to Q5.**

Q. 1. Which stage of cell division is shown in diagram?

(A) Prophase (B) Metaphase
(C) Anaphase (D) Telophase

Ans. Option (A) is correct.

Explanation: In Prophase, Chromosomes are duplicated, nuclear membrane is disappearing, nucleolus has disappeared.

Q. 2. Name the stage that follows the one shown here

(A) Interphase (B) Anaphase
(C) Telophase (D) Metaphase

Ans. Option (D) is correct.

Explanation: In mitosis, sequence of division is prophase, metaphase, anaphase, telophase, cytokinesis.

Q. 3. Name the type of cell shown in diagram.

(A) Plant cell (B) Animal cell
(C) Prokaryotic cell (D) None of the above

Ans. Option (B) is correct.

Explanation: Presence of centrioles indicates that the cell is an animal cell.

Q. 4. Mention one important feature of this stage.

(A) Nuclear membrane along with nucleolus disappears.
(B) Nuclear membrane does not disappear.
(C) Nuclear membrane along with nucleolus prominently present.
(D) Nuclear membrane along with nucleolus reappears.

Ans. Option (A) is correct.

Explanation: In this stage of cell division, the nuclear membrane disappears together with nucleolus and the chromosomes become short and thick.

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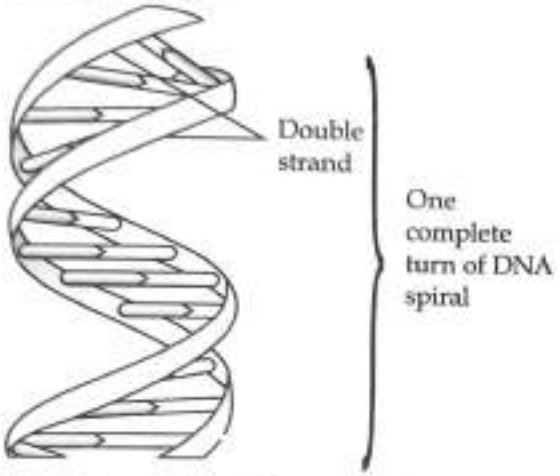
Q. 5. Where does this type of cell division usually occur?
(A) Germ cell
(B) Somatic cell
(C) In all types of cells
(D) None of the above

Ans. Option (B) is correct.

Explanation: Mitosis occurs in somatic cells, it takes place in all types of cells that are not involved in the production of gametes.

III. Given below is the diagram of double helix DNA structure. Study and answer any four question from Q1. to Q. 5.



Q. 1. What forms the back bone of this DNA structure?
(A) Purine-pyrimidine bases
(B) Sugar-phosphate bond
(C) Sugar-base bond
(D) Phosphate-base bond.

Ans. Option (B) is correct.

Explanation: The sugar-phosphate backbone forms the structural framework of nucleic acids, including DNA and RNA. The building blocks of DNA are nucleotides, which are made up of three parts: a deoxyribose (5-carbon sugar), a phosphate group, and a nitrogenous base.

Q. 2. Which of the following is not present in DNA helical structure?
(A) Phosphate group (B) Hydrogen bond
(C) Ribose sugar (D) Purine bases

Ans. Option (C) is correct.

Explanation: DNA consist of deoxy ribose sugar in its structure. Ribose sugar is present in RNA.

Q. 3. Where is DNA present in eukaryotic cell?
(A) Inside ribosome (B) In cytoplasm
(C) In nucleus (D) None of these

Ans. Option (C) is correct.

Explanation: In eukaryotic cell DNA is present inside a definite enveloped structure called nucleus. However, in prokaryotic cell, DNA is present naked in cytoplasm.

Q. 4. For the formation of chromatin, DNA binds with which of the following biomolecules?
(A) Carbohydrates (B) lipids
(C) Vitamins (D) Proteins

Ans. Option (D) is correct.

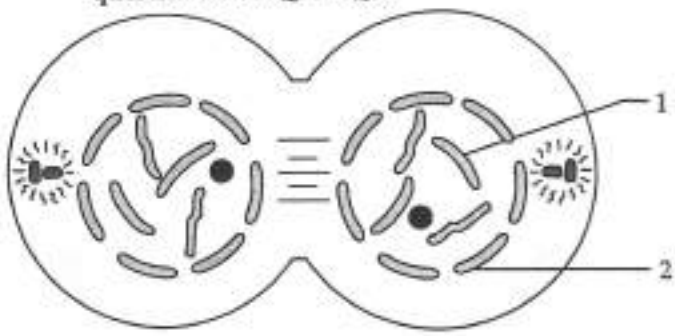
Explanation: DNA binds with histone and non histone proteins to form chromatin threads.

Q. 5. Which of the following nitrogenous base is not present in DNA?
(A) Uracil (B) Adenine
(C) Guanine (D) Cytosine

Ans. Option (A) is correct.

Explanation: Uracil is the nitrogenous base present in RNA molecule not in DNA.

AI IV. Given below is the diagram of stage of cell division. Observe carefully and answer any four questions from Q1 to Q5.



Q. 1. Which stage of cell division is shown in diagram?
(A) Prophase (B) Metaphase
(C) Anaphase (D) Telophase

Ans. Option (D) is correct.

Explanation: In telophase, nuclear membrane reappears, spindle fibres disappear, cytokinesis begins and the chromosomes begin to decondense.

Q. 2. Name the part labelled as 1 and 2 in the diagram.
(A) 1- Centromere 2- Chromosome
(B) 1- Nucleus 2- Cell wall
(C) 1- Nuclear membrane 2- Centriole
(D) 1- Chromosome 2- Nuclear membrane

Ans. Option (D) is correct.

Explanation: In telophase, nuclear membrane reappears and chromosome gets enclosed in it.

Q. 3. Name the type of cell shown in diagram.
(A) Plant cell (B) Animal cell
(C) Prokaryotic cell (D) None of the above

Ans. Option (B) is correct.

Explanation: Presence of centrioles indicates that the cell is an animal cell.

Q. 4. The term cytokinesis refers to:

(A) Division of cytoplasm

(B) Division of nucleus

(C) Division of cell membrane

(D) Replication of DNA

Ans. **Option (A) is correct.**

> *Explanation:* Cytokinesis is the process of division of cytoplasm after the division of nucleus which is called as karyokinesis.

Q. 5. After mitosis, how many daughter cells are produced?

(A) 1 (B) 2

(C) 3 (D) 4

Ans. **Option (B) is correct.**

> *Explanation:* Mitosis is a type of cell division in eukaryotes which produces 2 identical cells.

V. **Read the paragraph carefully. Answer any four questions from Q1 to Q5.**

Sudha planted a seed in the pot. After few days a small sapling appeared from the seed. She takes proper care of her plant in the pot. Plant was growing day by day. After few weeks, flowers appeared on the plant. Sudha was very happy to see the flowers.

Q. 1. What was the main reason for the plant growth?

(A) Pot of the plant.

(B) Plant cells were static.

(C) Plants cells were going under cell division continuously.

(D) Plant cells were inactive.

Ans. **Option (C) is correct.**

> *Explanation:* For the growth and development of plant a continuous cell division is necessary.

Q. 2. What type of cell division takes

(A) Mitosis (B) Meiosis

(C) None (D) Both

Ans. **Option (A) is correct.**

> *Explanation:* Leaves are vegetative part of the plant. In vegetative cells only mitosis takes place.

Q. 3. In which part of the plant meiosis takes place?

(A) Root (B) Leaves

(C) Flower (D) Stem

Ans. **Option (C) is correct.**

> *Explanation:* Flower is the reproductive structure of the plant. Meiosis takes place in flower to produce gametes i.e. egg and sperms inside ovary and anther.

Q. 4. After meiosis, cells produced are:

(A) Haploid (B) Diploid

(C) Polyploid (D) Aneuploid

Ans. **Option (A) is correct.**

> *Explanation:* Meiosis is a reduction division in which the number of chromosomes reduced to half. Thus, the cell produced after meiosis are haploid in nature.

Q. 5. In plant cell, cytokinesis takes place through:

(A) Cell wall formation

(B) Cell plate formation

(C) Formation of furrows

(D) Formation of grooves

Ans. **Option (B) is correct.**

> *Explanation:* Cytokinesis is the process of division of cell cytoplasm after nuclear division. In plant cell it occurs through the cell plate formation in the middle of the cell.

❐❐

Genetics

Laws of Mendel's inheritance

- **Law of dominance**: Out of a pair of contrasting characters present together, only one is able to express itself while other remains suppressed
- **Law of segregation**: The two members of a pair of factors separate during gamete formation.
- **Law of independent assortment**: When there are two pairs of characters the distribution of the alleles of one character into the gametes is independent of the distribution of alleles of other character

Chromosomes

Carriers of heredity

- **Autosomes**: Identical chromosomes from 1-22
- **Sex chromosomes**: 23rd pair is different. Male - XY; female - XX

Mutation

These are permanent changes in a gene or a chromosome that occur spontaneously or can be induced.

Heredity

It is the transmission of genetically based characteristic from parents to offspring.

Variations

These are small differences among individuals

Genes

Genes are specific parts of a chromosome, which determine the hereditary characteristics.

Allele

Alternative form of a gene is known as allele.

- **Types of allele**
  - Dominant allele (Super ruling)
  - Recessive allele (Subordinate or submissive)

Sex linked inheritance

It is the appearance of a trait by an allele either on X chromosome or Y chromosome.

- **X linked inheritance**: e.g. Haemophilia and Colour blindness.
- **Y linked inheritance**: e.g. Baldness.

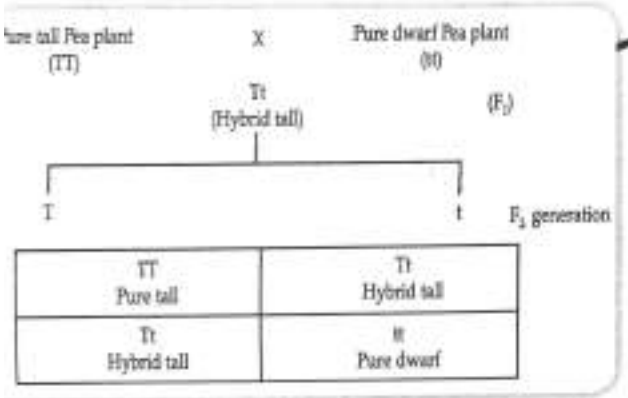
Phenotype

The observable characteristics which are genetically controlled.

Genotype

The set of genes present in the cells of an organism.

Monohybrid cross



Trace the Mind Map

- First Level
- Second Level
- Third Level

CHAPTER 2

GENETICS

RATNESH SINGH

Syllabus

- *Genetics : Mendel's laws of inheritance.*

REVISION NOTES

Definition of Genetics and Related Terms

- **Genetics**
  - (i) The term genetics was proposed by William Bateson.
  - (ii) Genetics is the branch of biology that deals with the study of inheritance and variation of characters from parent to offsprings.
  - (iii) The kind of transmission of characters from parent to offsprings is called **heredity** or **inheritance**. Like wise, no two individuals of a species are alike, such differences are called **variations**.

- **Terms Related to Genetics**
  - **Monohybrid Cross is** the inheritance of one pair of contrasting characters. For example, a cross between a pea plant with a dominant green seed and one with a recessive yellow seed.
  - **Dihybrid Cross** is inheritance of two pairs of contrasting characters. For example, the inheritance of yellow and round seed character with the green and wrinkled character is a **dihybrid cross**.
  - **Gene :** Mendel presumed that a character is determined by a pair of factors present in each cell of an individual. These are known as genes in modern genetics.
  - **Allele or allelomorph:** They are various forms of a gene or Mendelian factor which occurs on the same locus on homologous chromosomes and control the same character. Alleles or allelomorphs control different expressions or traits of the same character (e.g., tallness and dwarfness in Pea).
  - **Heterozygous:** An individual having two contrasting Mendelian factors or genes for a character. Heterozygote or heterozygous individual is also called hybrid. e.g., Tt.
  - **Homozygous:** An individual having identical Mendelian factors or genes for a character (TT or tt). Homozygous or homozygotic individual is always pure for the trait.
  - **Dominant Factor:** An allele or Mendelian factor which expresses itself in the hybrid (heterozygote) as well as in the homozygous state. It is denoted by capital letter (T for tallness).
  - **Recessive Factor:** An allele or Mendelian factor which is unable to express itself in the hybrid or in the presence of alternate (dominant) allele. It is denoted by small letter (t for dwarfness). The recessive factor expresses itself only in the homozygous state (e.g., tt).
  - **Mutation:** Sudden changes in one or more genes in the progeny, which normally may not have existed in the parents, grand parents or even great grandparents are called mutations. For example : albinism, sickle cell anaemia.

Scan to know more about this topic

Terms Related to Genetics

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- **Mutation** may be of gene mutation – changes in the DNA and chromosomal mutation – changes in the number of arrangement of the chromosome.
- **Variation:** The differences among the members of same species and offspring of the same parents are referred to as variation.
- **Genotype:** It is the gene complement or genetic constitution of an individual with regard to one or more characters irrespective of whether the genes are expressed or not. For example, the genotype of hybrid tall pea plant is Tt, pure tall TT and dwarf tt.
- **Phenotype :** The observable, morphological or physiological expression of an individual with regard to one or more characters is called phenotype. For recessive gene, the phenotype is similar to genotype. For dominant genes, the phenotypic expression can be due to its homozygous genotype or heterozygous genotype. For example, phenotypic tall pea plant can be genotypically TT or Tt.

Mendel's Laws of Inheritance

➢ **Introduction**

- G. J. Mendel (1822-1884), the father of genetics, was an Austrian monk.
- He was the 1st scientist who made a systematic study of patterns of inheritance of characters from parents to progeny.
- He carried out breeding experiments on garden pea plants (*Pisum sativum*) and formulated basic laws of heredity.
- Mendel crossed a pure tall garden pea plant and a pure dwarf pea plant, the resulting offspring were called F_1 generation.

➢ **Selection of Pea Plant**

- Mendel selected pea plant for his experiments because
  - (i) Garden pea has distinct, easily detectable contrasting traits.
  - (ii) The plant reproduces well and grows to maturity in a single season.
  - (iii) The pea plant is self pollinating in nature because pea flower is bisexual.
  - (iv) Self pollination could be prevented by removing the male reproductive parts of the flower.
  - (v) Cross-pollination could be done artificially.

➢ **Mendel's Laws of Inheritance**

➢ **Law of Paired Factor:** A character is represented in an individual (diploid) by at least two factors. The two factors lies on the two homologous chromosomes at the same locus.

- They may represent the same (homozygous, e.g., TT in case of pure tall pea plant, tt in case of dwarf pea plant) or alternate expression (heterozygous e.g., Tt in case of hybrid tall pea plant) of the same character.

Scan to know more about this topic

Mendel's Law of Inheritance

➢ **Law of Dominance:** In a hybrid, where both the contrasting alleles or unit factors are present, only one unit factor /allele called dominant is able to express itself while the other factor/allele called recessive remains suppressed.

- In a cross between pure breeding red flower (RR) pea plant and white flower (rr) pea plant, the F_1 generation is red flowered though it has received both the factors (R and r).
- It is because of the dominant nature of factor for red flower colour and recessive nature of the factor for white flower colour.
- On self breeding, the recessive trait reappear in the F_2 generation showing that it is suppressed in F_1 generation, and not lost.

➢ **Law of Segregation:** Law of segregation states that the two contrasting factors do not mix in the F_1 generation but segregate or separate from each other at the time of gamete formation.

- Mendel continued his experiments further and allowed self pollination in F_1 hybrids.
- The resultant off springs were called F_2 generation.
- In F_2 generation tall and dwarf plants are formed in 3 : 1 ratio, so that each gamete receive only one factor, either dominant or recessive. Hence, gametes are pure.
- Thus law of segregation is also referred to as law of purity of gametes.

Pure tall Pea plant (TT) × Pure dwarf Pea plant (tt)

(F_1 generation)

Tt (Hybrid tall)

Alok

	T	t
T	TT Pure tall	Tt Hybrid tall
t	Tt Hybrid tall	tt Pure dwarf

(F_2 generation)

Phenotypic ratio = 3 : 1 (3 tall and 1 dwarf)

Genotypic ratio = 1 : 2 : 1 (1 Pure tall : 2 Hybrid tall : 1 Pure dwarf)

➢ **Law of independent assortment**

It states that the factors of different pairs of contrasting characters behave independent to each other at the time of gamete formation, and at the time of fertilization they bring about all the possible combinations of characters.

- Mendel crossed a pure yellow, round seeded garden pea plant with a pure green, wrinkled seeded garden pea plant. All F_1 individuals show yellow, round characters.
- In F_1 dihybrids yellow character is dominant over green character and round character is dominant over wrinkled character.
- Mendel allowed self pollination of F_1 dihybrids and observed F_2 generation.
- In F_2 generation, he found yellow round; yellow wrinkled; green round; green wrinkled pea plants in 9 : 3 : 3 : 1 ratio.
- In the above cross, in F_2 generation, two more new varieties of pea plants are formed besides the parents. They are yellow, wrinkled and green, round plants.

YYRR (Yellow, Round) × yyrr (green, wrinkled)

YR yr

YyRr (F_1 generation)

(Yellow, round)

	YR	Yr	yR	yr
YR	YYRR Yellow, Round	YyRr Yellow, Round	YyRR Yellow, Round	YyRr Yellow, Round
Yr	YYRr Yellow, Round	YYrr Yellow, Wrinkled	YyRr Yellow, Round	Yyrr Yellow, Wrinkled
yR	YyRR Yellow, Round	YyRr Yellow, Round	yyRR Green, Round	yyRr Green, Round
yr	YyRr Yellow, Round	Yyrr Yellow, Wrinkled	yyRr Green, Round	yyrr Green, Wrinkled

(F_2 generation)

Phenotypic Ratio – 9 : 3 : 3 : 1

Yellow, Round – 9

Yellow, Wrinkled – 3

Green, Round – 3

Green, Wrinkled– 1

This ratio is called Mendel's dihybrid phenotypic ratio.

Sex Linked Inheritance of Diseases

- Sex linked inheritance was first discovered by Morgan (1910) in *Drosophila*.
- In man, two sex linked disorders are haemophilia and colour blindness.
- In haemophilia, blood clotting mechanism is absent. The person with colour blindness cannot distinguish colours.
- Haemophilia and colour blindness are caused by recessive genes present on X chromosome.
- The above two disorders are common in males than females, because the gene is located on the X chromosome. As there are two X chromosomes in females out of which only one gets affected usually, so, the disease is not expressed. On the other hand, males have only one X chromosome, so the disease is expressed in males.

➢ **Inheritance of Diseases**

- When a normal man marries a colour blind female., expected vision of their children may be shown as:

XY (normal male)	$X^0 X^0$ (colour blind female)
X Y	$X^0 X^0$
XX^0 (normal carrier female)	X X^0 (normal carrier female)
X^0 Y (colour blind male)	X^0 Y (colour blind male)

Result: All male children are colour blind and all female children are carrier.

➢ Inheritance of X-liked genes as in colour blindness and haemophilia is called criss-cross inheritance.

➢ This is because the son (male) may get it from the otherwise normal but carrier mother and a colour blind father may pass it on to the daughter making her colour-blind if the mother is carrier.

Scan to know more about this topic

Laws of Mendel and Sex Linked Inheritance

MNEMONICS

Concept : Mendel's Law of Inheritance

Mnemonics : Prepare Drawing for School Institute

Interpretation:
Law of Paired Factor, Law of Dominance, Law of Segregation, Law of Independent Assortment

Genetic Disorder

Mnemonics : Never Come Home Alone

Interpretation:
Night Blindness, Colour blindness, Haemophilia, Albinism

KNOW THE TERMS

- **Character:** It is well defined morphological or physiological feature of an organism. eg. Stem height.
- **Gene symbol:** Each character is provided with a symbol. eg. T for tallness and t for dwarfness.
- **Gene locus:** A particular region of the chromosome representing a single gene is called gene locus.
- **Hybrid:** The heterozygous organism produced after crossing two genetically different individuals is called a hybrid .
- **Pure line:** It is a strain of true breeding individuals which have homozygous traits due to continued self breeding over the generations.
- **Genome:** It is a complete set of chromosomes where every gene and chromosome is represented singly as in a gamete.
- **Gene pool:** The aggregate of all the genes and their alleles present in an interbreeding population is known as gene pool.
- **Backcross:** It is a cross between hybrid and one of its parents in order to increase the number of traits of that parent.
- **Test cross:** It is a cross between an individual with a dominant trait and a recessive organism in order to know whether the dominant trait is homozygous or heterozygous.

MULTIPLE CHOICE QUESTIONS

STAND ALONE MCQs

Q. 1. Alleles

(A) Various forms of gene which occurs on the different locus on homologous chromosomes

(B) Various forms of gene which occurs on the same locus on homologous chromosomes

(C) Various forms of gene which occurs on the same locus analogous chromosomes

(D) Various forms of DNA which occurs on the same locus on homologous chromosomes

Ans. Option (B) is correct.

> ***Explanation:*** They are various forms of a gene or Mendelian factor which occurs on the same locus on homologous chromosomes and control the same character. Alleles or allelomorphs control different expressions or traits of the same character (e.g., tallness and dwarfness in Pea).

Q. 2. Phenotype

(A) The physical or the observable characteristic of chromosome

(B) The genetic characteristic of an organism

(C) The non observable characteristic of an organism

(D) The physical or the observable characteristic of an organism

Ans. Option (D) is correct.

> ***Explanation:*** The observable, morphological or physiological expression of an individual with regard to one or more characters is called phenotype.

PU Q. 3. Dihybrid cross

(A) Breeding of plants taking two pairs of contrasting characters

(B) Breeding of plants taking two pairs of similar characters

(C) Breeding of plants taking three pairs of contrasting characters

(D) Breeding of plants taking a pair of characters

Ans. Option (A) is correct.

> ***Explanation:*** Dihybrid Cross is inheritance of two pairs of contrasting characters. For example, the inheritance of yellow and round seed character with the green and wrinkled character is a dihybrid cross.

Q. 4. Heterozygous chromosome

(A) A single chromosomes carrying dissimilar alleles of a particular character

(B) A pair of chromosomes carrying similar alleles of a particular character

(C) A pair of chromosomes carrying dissimilar alleles of a particular character

(D) A pair of chromosomes carrying dissimilar alleles of contrasting character

Ans. Option (C) is correct.

> ***Explanation:*** An individual having two contrasting Mendelian factors or genes for a character. Heterozygote or heterozygous individual is also called hybrid. e.g., Tt.

Q. 5. In which of the following condition, the recessive gene expresses itself? (ICSE 2013)

(A) Heterozygous condition

(B) Homozygous condition

(C) F_2- generation

(D) Y-linked inheritance.

Ans. Option (B) is correct.

> ***Explanation:*** Only in homozygous condition recessive gene will be expressed. In heterozygous condition the dominant gene will dominate over the recessive one and expresses itself.

Q. 6. In a human female, ovum consists of:

(A) 23 pairs of autosomes

(B) 22 pairs of autosomes and 1 pair of sex chromosomes

(C) 22 autosomes and 1 Y-chromosome

(D) 22 autosomes and 1 pair of X-chromosome

Ans. Option (D) is correct.

> ***Explanation:*** Human female ovum consists of 22 pairs of autosomes and one pair of sex chromosomes.

Q. 7. A mature sperm of human male contains:

(A) Both X and Y chromosomes

(B) Only Y chromosome

(C) Only X chromosome

(D) Either X or Y chromosome.

Ans. Option (D) is correct.

> ***Explanation:*** Human male contains XY as sex chromosome. Thus, the sperm will contain either X or Y chromosome.

Q. 8. Which type of gene is only expressed if there are two genes of that type of gene are present?

(A) Dominant

(B) Recessive

(C) Co-dominant

(D) Mutant

Ans. Option (B) is correct.

Explanation: In homozygous condition when two recessive genes are present, it will be expressed. In heterozygous condition where two different alleles are present then the dominant one will be expressed.

Q. 9. The technical term for the sudden inheritable change in the gene

(A) Allele (B) Mutation
(C) Variation (D) Autosome

Ans. Option (B) is correct.

Explanation: Mutation is a sudden change in one or more genes or in the number or in the structure of chromosomes. It is a rare, random and discontinuous inheritable change in the genetic material of an organism.

Q. 10. Name the pair of genes responsible for a particular characteristic in an individual.

(A) Homologous chromosome
(B) Trait
(C) Alleles
(D) Factor

Ans. Option (C) is correct.

Explanation: Alleles are various forms of a gene or Mendelian factor which occurs on the same locus on homologous chromosomes and control the same character. Alleles or allelomorphs control different expressions or traits of the same character (e.g., tallness and dwarfness in Pea).

Q. 11. Identify the odd one from the following term:

(A) Chicken pox (B) Colour blindness.
(C) Haemophilia (D) Albinism.

Ans. Option (A) is correct.

Explanation: Colour blindness, Haemophilia and Albinism are genetic disorders. However, Chicken pox is a viral communicable disease.

Q. 12. Name the physical expression of genes in an individual.

(A) Genotype (B) Allotype
(C) Homozygous (D) Phenotype

Ans. Option (D) is correct.

Explanation: The observable, morphological or physiological expression of an individual with regard to one or more characters is called phenotype. For recessive gene, the phenotype is similar to genotype. For dominant genes, the phenotypic expression can be due to its homozygous genotype or heterozygous genotype.

Q. 13. Identify the type of gene, which in the presence of contrasting allele is not expressed.

(A) Recessive (B) Dominant
(C) Co-dominant (D) Co-recessive

Ans. Option (A) is correct.

Explanation: In homozygous condition recessive gene will be expressed. However, heterozygous condition where contrasting dominant gene is present, it will dominate over the recessive one and expresses itself.

Q. 14. Which of the following statement is true for autosomes?

(A) Chromosomes other than the pair of sex chromosomes are autosomes.
(B) Autosomes are the genetic makeup of an organism.
(C) Autosomes are the physical or the observable characteristics of an organism.
(D) Sex chromosomes are also called as autosomes.

Ans. Option (A) is correct.

Explanation: Autosomes are the chromosomes having genes for anything that is not related with sex determination. They carry genes that control somatic traits.

AI **Q. 15.** After crossing of pure breed tall plant with round seed and short plant with wrinkled seeds, the possible outcome of F_2 generation will be:

(A) Tall plant with round seeds
(B) Tall plant with wrinkled seeds
(C) Short plant with round seed
(D) All of the above

Ans. Option (D) is correct.

Explanation: In a dihybrid cross, the progeny of F_2 generation will have four types of phenotype in a ratio of 9:3:3:1. These are tall plant and round seeds, tall plant wrinkled seed, short plant and round seed and short plant wrinkled seed.

Q. 16. What is the phenotypic ratio of F_2 generation if homozygous dominant plant is crossed with homozygous recessive plant in monohybrid cross?

(A) 1: 2: 1 (B) 3: 1
(C) 9: 3: 3: 1 (D) 1: 1: 1: 1

Ans. Option (B) is correct.

Explanation: In a monohybrid cross, the progeny of F_2 generation will have four types of phenotype in a ratio of 3: 1.

Q. 17. How many pairs of sex chromosome are present in zygote of human beings?

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

Ans. Option (A) is correct.

Explanation: In human beings, male gametes (sperm) contain either X or Y chromosome, while female gamete (egg) contains only X-chromosome. When zygote is formed, it contains 1 pair of sex chromosome.

Q. 18. Mendel selected pea plant for his experiments because:

(A) The pea plant is bisexual and self pollinating in nature.
(B) The pea plant has beautiful flowers.
(C) Cross pollination is impossible in pea plants
(D) All of the above

Ans. Option (A) is correct.

> ***Explanation:*** The pea plant is self pollinating in nature because pea flower is bisexual. Self pollination could be prevented by removing the male reproductive parts of the flower. Cross-pollination could be done artificially..

Q. 19. Which of the following is heterozygous?

(A) RR (B) rrtt
(C) RRTT (D) Rr

Ans. Option (D) is correct.

> ***Explanation:*** An individual having two contrasting Mendelian factors or genes for a character. Heterozygote or heterozygous individual is also called hybrid. e.g., Rr.

ASSERTION AND REASON MCQs

Directions: In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both (A) and (R) are true, and (R) is the correct explanation of (A).
(B) Both (A) and (R) are true, but (R) is not the correct explanation of (A).
(C) (A) is true, but (R) is false.
(D) (A) is false, but (R) is true.

Q. 1. Assertion (A): Sex of the progeny in humans is decided by the chromosome received from father.

Reason (R): Human male sperm has one X chromosome and one Y chromosome.

Ans. Option (A) is correct.

> ***Explanation:*** If child gets X chromosome will be a female and if child gets Y chromosome will be a male. Chromosome of mother does not decide the sex of progeny.

Q. 2. Assertion (A): Mutation is sudden changes in one or more genes in the progeny.

Reason (R): Variation is important for the survival of the species in long term.

Ans. Option (B) is correct.

> ***Explanation:*** Mutation is a rare, random, discontinuous inheritable change in the genetic material of an organism. Variation is the differences among the members of same species and offspring of the same parents are referred to as variation.

Q. 3. Assertion (A): Genotype is the gene complement or genetic constitution of an individual.

Reason (R): For recessive gene, the phenotype is dissimilar to genotype.

Ans. Option (C) is correct.

> ***Explanation:*** Genotype of the organism includes all dominant and recessive characters. For recessive gene, the phenotype is similar to genotype. For dominant genes, the phenotypic expression can be due to its homozygous genotype or heterozygous genotype.

Q. 4. Assertion (A): Chromosomes other than the pair of sex-chromosome are called alleles.

Reason (R): Alleles or allelomorphs control different expressions or traits of the same character.

Ans. Option (D) is correct.

> ***Explanation:*** Autosomes are chromosomes other than the sex chromosomes. These are chromosomes that contain genes for anything that does not relate to sex determination.

AI **Q. 5. Assertion (A):** Colour blindness is more common in men than women.

Reason (R): Colour blindness is more common in men than in women because men only have one X chromosome, while women have two X chromosome.

Ans. Option (A) is correct.

> ***Explanation:*** Inheritance of X-liked genes as in colour blindness is called criss-cross inheritance. This is because the son (male) may get it from the otherwise normal but carrier mother and a colour blind father may pass it on to the daughter (female) making her colour-blind if the mother is carrier.

Q. 6. Assertion (A): Mendel selected pea plants for his experiment.

Reason (R): Pea plants were the only plants he could gather for his experiment.

Ans. Option (C) is correct.

Explanation: Mendel selected pea plant for his experiments because garden pea has distinct, easily detectable contrasting traits. Also the pea plant is self pollinating in nature because pea flower is bisexual. Self pollination could be prevented by removing the male reproductive parts of the flower. Cross-pollination could be done artificially.

AI Q. 7. **Assertion (A):** In a cross between pure breeding red flower (RR) pea plant and white flower (rr) pea plant, the F_1 generation is red flowered though it has received both the factors (R and r).

Reason (R): The dominant nature of factor for red flower colour and recessive nature of the factor for white flower colour give the colour to the flower.

Ans. Option (A) is correct.

Explanation: In a hybrid, where both the contrasting alleles and unit factors are present, only one unit factor /allele called dominant is able to express itself while the other factor/ allele called recessive remains suppressed.

Q. 8. Assertion (A): Characters such as tallness and dwarfness in pea plant are inherited independently.

Reason (R): When a homozygous tall pea plant is crossed with dwarf pea plant, medium sized pea plant is obtained in F_1 generation.

Ans. Option (C) is correct.

Explanation: When a homozygous tall pea plant is crossed with dwarf pea plant, all tall pea plants are obtained in F_1 generation.

Q. 9. **Assertion (A):** Monohybrid Cross is the inheritance of one pair of contrasting characters.

Reason (R): Dihybrid Cross is inheritance of two pairs of contrasting characters.

Ans. Option (B) is correct.

Explanation: In monohybrid cross, only one trait is taken for consideration. The different forms of the characteristic are usually controlled by different alleles of the same gene.

Q. 10. **Assertion (A):** Eye colour, hair colours and height are traits which are not inherited from parents.

Reason (R): Inherited traits are transferred from parents to children.

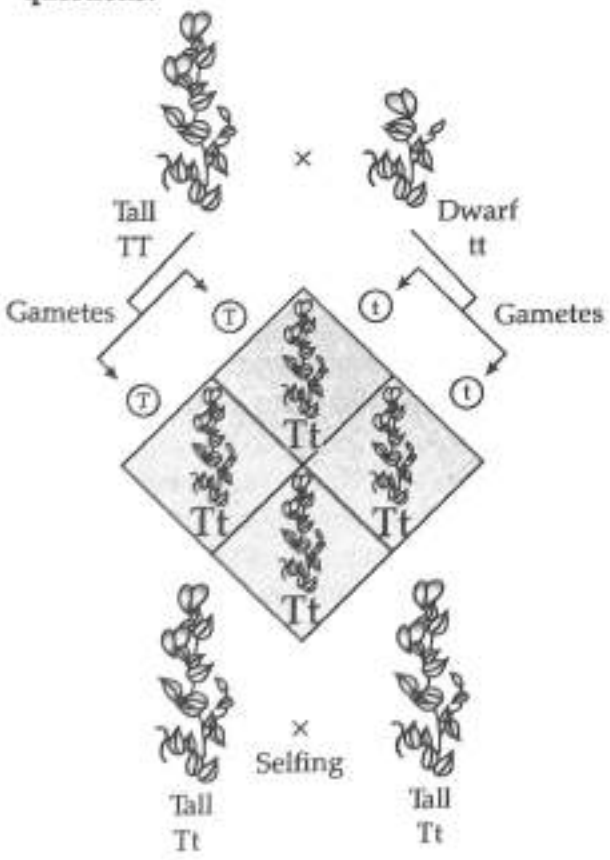
Ans. Option (D) is correct.

Explanation: Eye colour, hair colours and height are genetically inherited traits. These are expressed by genes and are transferred from parents to off spring.

CASE-BASED MCQs

Picture Based Questions

AI **I. Study the image given carefully and answer the questions.**



Q. 1. Which of the two contrasting trait is dominant?

(A) Tall (B) Dwarf
(C) Co-dominant (D) None

Ans. Option (A) is correct.

Explanation: After F1 generation all progeny are tall, thus tall is dominant over dwarf.

Q. 2. Which Mendel Law is applicable in Q1?

(A) Law of dominance
(B) Law of segregation
(C) Law of independent assortment
(D) Law of purity of gamete.

Ans. Option (A) is correct.

Explanation: In a hybrid, where both the contrasting alleles or unit factors are present, only one unit factor/allele called dominant, is able to express its effect while the other factor allele called recessive, remains suppressed.

Q. 3. What is the phenotypic ratio after selfing in F2 generation?

(A) 1 : 2 : 1 (B) 3 : 1
(C) 1 : 1 : 1 : 1 (D) 9 : 3 : 3 : 1

Ans. Option (B) is correct.

Explanation: In F2 generation tall and dwarf plants are formed in 3 : 1 ratio, so that each gamete receive only one factor, either dominant or recessive.

Q. 4. What is the genotypic ratio after selfing in F_2 generation?

(A) 1 : 2 : 1 (B) 3: 1

(C) 9: 3: 3: 1 (D) 1: 1: 1: 1

Ans. Option (A) is correct.

> *Explanation:* Genotype after selfing are TT, Tt and tt in a ratio of 1 : 2 : 1.

Q. 5. Define Mutation.

(A) Regular change in one or more genes or in the number or in the structure of chromosomes.

(B) Sudden change in one or more genes only.

(C) Sudden change in one or more genes or in the number or in the structure of chromosomes.

(D) Sudden non inheritable change in one or more genes or in the number or in the structure of chromosomes.

Ans. Option (C) is correct.

> *Explanation:* Sudden changes in one or more genes in the progeny, which normally may not have existed before. Mutation may be of gene mutation – changes in the DNA and chromosomal mutation – changes in the number of arrangement of the chromosome.

II. Read the paragraph and study the image carefully. Answer the questions from Q1 to Q5.

G. J. Mendel (1822-1884), the father of genetics, was an Austrian monk. He was the 1st scientist who made a systematic study of patterns of inheritance of characters from parents to progeny. He carried out breeding experiments on garden pea plants (*Pisum sativum*) and formulated basic laws of heredity. Mendel crossed a pure tall garden pea plant and a pure dwarf pea plant, the resulting offspring were called F_1 generation. Mendel continued his experiments further and allowed self pollination in F_1 hybrids. The resultant off springs were called F_2 generation.

Gregor Johann Mendel

Q. 1. Which of the following is not Mendel's laws of inheritance?

(A) The law of dominance.

(B) The law of segregation.

(C) The law of independent assortment.

(D) The law of impure gametes.

Ans. Option (D) is correct.

> *Explanation:* The law of segregation is also referred to as law of purity of gametes. In F_2 generation tall and dwarf plants are formed in 3 : 1 ratio, so that each gamete receive only one factor, either dominant or recessive. Hence, gametes are pure.

Q. 2. Mendel selected pea plant for his experiments because:

(A) Garden pea has distinct, easily detectable contrasting traits.

(B) The plant reproduces well and grows to maturity in a single season with less generation time.

(C) The pea plant is self pollinating in nature because pea flower is bisexual.

(D) All of the above.

Ans. Option (D) is correct.

> *Explanation:* Self pollination could be prevented by removing the male reproductive parts of the flower. Cross-pollination could be done artificially.

Q. 3. Which law of Mendel states " the two contrasting factors do not mix in the F_1 generation but separate from each other at the time of gamete formation"?

(A) The law of dominance,

(B) The law of segregation,

(C) The law of independent assortment

(D) None of the above

Ans. Option (B) is correct.

> *Explanation:* During the formation of gametes, the paired factors or traits separate, or segregate, randomly so that each gamete receives one or the other with equal likelihood. If an individual contains a pair of like factors, then all its gametes receive one of those same kinds of factor.

Q. 4. Which one of following is the phenotypic ratio of the F_2 generation?

(A) 1: 2: 1 (B) 3: 1

(C) 9: 3: 3: 1 (D) 1: 1: 1: 1

Ans. Option (C) is correct.

> *Explanation:* Mendel allowed self pollination of F_1 dihybrids and observed F_2 generation. In F_2 generation, he found yellow round; yellow wrinkled; green round; green wrinkled pea plants in 9 : 3 : 3 : 1 ratio. In this cross, after F_2 generation, two more new varieties of pea plants are formed besides the parents. They are yellow, wrinkled and green, round plants.

Q. 5. What was the term used by Mendel for "gene"?

(A) Factor (B) Trait
(C) Element (D) Unit

Ans. Option (A) is correct.

> *Explanation:* Mendel found that there are alternative forms of factor which we now called genes that account for variations in inherited characteristics.

III. Read the paragraph and study image carefully. Answer the questions from Q1. to Q5.

Pea plant can have green pods or yellow pod. Also pods are either constricted or inflated. A Scientist decided to pollinate a pea plant which is homozygous for green pods which are inflated (GGII) with a homozygous plant for yellow pods which are constricted (ggii). Resulting pods were all green and inflated.

Pisum Sativum

Pea Plant

Pure pea plants with green, inflated pods
GGII
GI

×

Pure pea plants with yellow, constricted pods
ggii
gi

Q. 1. What will be the genotype of pea plants after F_1 generation?

(A) Ggli (B) GGII
(C) Ggii (D) ggII

Ans. Option (A) is correct.

> *Explanation:* A character is represented in an individual (diploid) by at least two factors. The two factors lies on the two homologous chromosomes at the same locus. In a cross between pure breeding green and inflated (GGII) pea pod and yellow and constricted (ggii) pea pod, the F_1 generation is pea pod has received both the factors (G, g and I, i).

Q. 2. In Law of dominance, what does 9: 3: 3: 1 ratio in F_2 generation represents?

(A) Phenotypic ratio
(B) Genotypic ratio
(C) Both Genotypic and phenotypic ratios
(D) None

Ans. Option (A) is correct.

> *Explanation:* A ratio of 9: 3: 3: 1 is at ratio of phenotypes among offsprings that results when two dihybrids mate. Here allele G is dominant over g and I is dominant over i giving four different types of phenotypes.

Q. 3. Which type of pollination has occurred to produce F_1 generation?

(A) Self pollination (B) Cross pollination
(C) Self breeding (D) No pollination

Ans. Option (B) is correct.

> *Explanation:* The F_1 generation results from cross-pollination of two pure breeding parent plants will be exactly like the dominant parent plant.

Q. 4. What will be the possible combinations of the gametes that can be obtained if two F_1 hybrid plants are crossed?

(A) GI, Gi, gg, II (B) gi, ii, GG, gg
(C) GI, GI, gi, gi (D) GI, Gi, gI, gi

Ans. Option (D) is correct.

> *Explanation:* There are four possible combinations of gametes for the Ggli parent. Half of the gametes get a dominant G and g dominant I allele; the other half of the gametes get a recessive a and a recessive i allele. Both parents produce 25% each of GI, Gi, gI, gi

Q. 5. The characters which appear in the first filial generation are called

(A) Recessive characters
(B) Dominant characters
(C) Lethal character
(D) Co dominant characters

Ans. Option (B) is correct.

> *Explanation:* In a hybrid, where both the contrasting alleles / unit factors are present, only one unit factor /allele called dominant is able to express itself while the other factor/ allele called recessive remains suppressed.

IV. Read the paragraph and observe the carefully. Answer the from Q1 to Q5.

Riya wanted to find out the genotype of a pea plant having purple coloured flower in her kitchen garden. For this she crossed purple coloured plant with white coloured plant. As a result, all the plant produced had purple coloured flowers. So she decided for F_2 generation by selfing these plants of F_1 generation. On selfing, she got 25% plants with white flowers and 75% plants with purple flowers. Now she can determine the genotype of purple coloured plant by crossing it with white coloured plants.

Q. 1. What could be the reason for purple flower after crossing purple coloured flower with white coloured flower in F_1 generation?

(A) The law of dominance,

(B) The law of segregation,

(C) The law of independent assortment

(D) The law of independent assortment

Ans. Option (A) is correct.

> ***Explanation:*** In a hybrid, where both the contrasting alleles and unit factors are present, only one unit factor /allele called dominant is able to express itself while the other factor/ allele called recessive remains suppressed. The dominant nature of factor for purple flower colour and recessive nature of the factor for white flower colour give purple colour to the flower.

Q. 2. In white flowered plant, allele is expressed in

(A) Heterozygous condition

(B) Homozygous condition

(C) Will not be expressed

(D) F_3 generation.

Ans. Option (B) is correct.

> ***Explanation:*** Only in homozygous condition recessive gene will be expressed. In heterozygous condition the dominant gene will dominate over the recessive one and expresses itself.

Q. 3. What is the genotype of individual obtained after F_1 generation?

(A) All are homozygous dominant

(B) All are homozygous recessive

(C) All are hybrid/heterozygous recessive

(D) All are hybrid/heterozygous dominant

Ans. Option (D) is correct.

> ***Explanation:*** All individual are hybrid/ heterozygous dominant because purple coloured flower is dominant over white colour.

Q. 4. The character purple colour of flower that appeared in F_1 generation is called

(A) Expression character

(B) Lethal character

(C) Dominant character

(D) Recessive character.

Ans. Option (C) is correct.

> ***Explanation:*** The character purple colour of flower that appeared in F_1 generation is called dominant character. Dominant characters are able to expressed themselves even in heterozygous condition.

Q. 5. What is the scientific name of Pea plant?

(A) *Pisum sativum* (B) *Pisum litrosa*

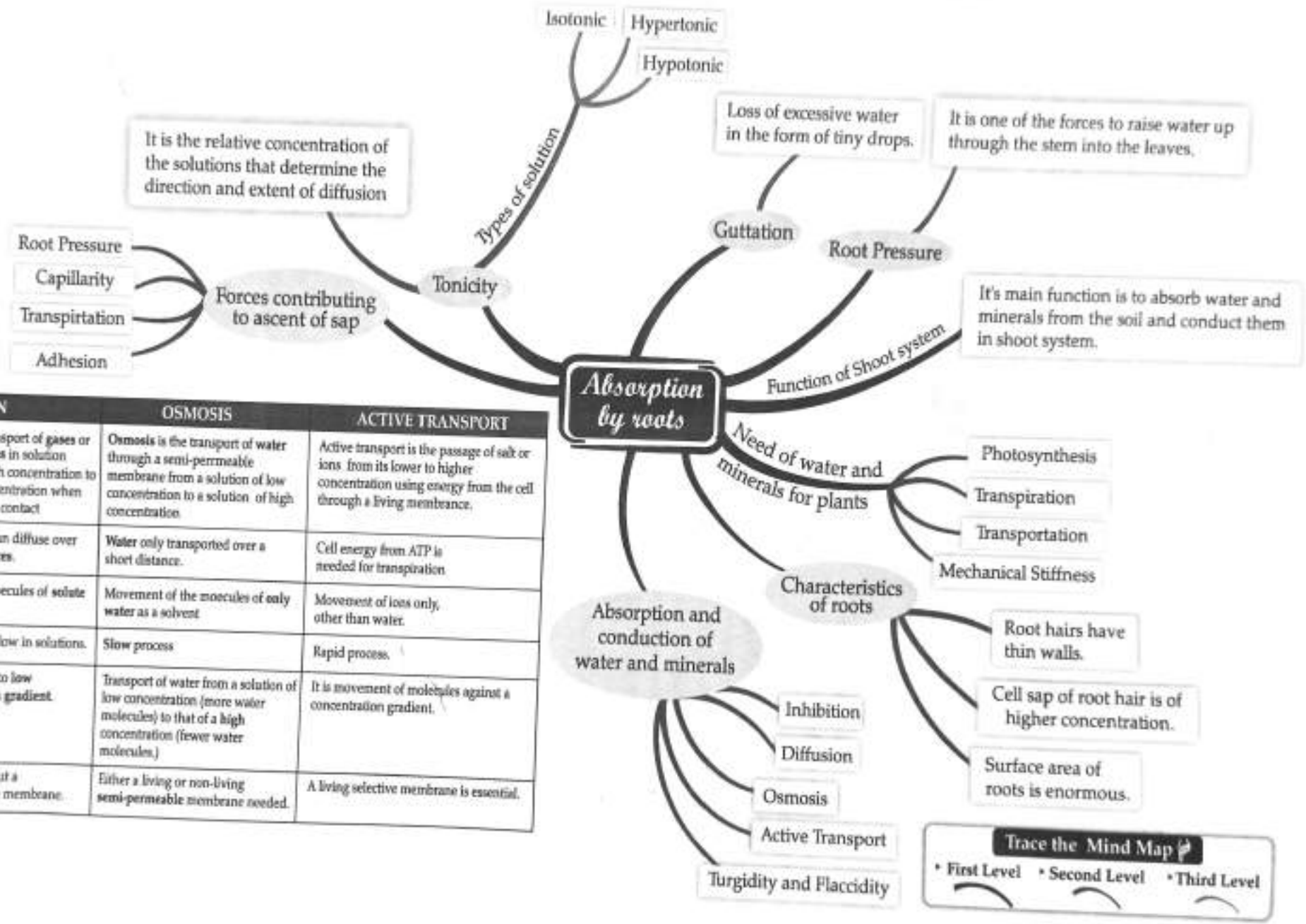
(C) *Poa litros* (D) *Poa sativum*

Ans. Option (A) is correct.

> ***Explanation:*** Pea i.e. *Pisum sativum*, also called garden pea, is a herbaceous annual plant in the family Fabaceae, grown virtually worldwide for its edible seeds.

❑❑

RATNESH SINGH



DIFFUSION	OSMOSIS	ACTIVE TRANSPORT
1. **Diffusion** is the transport of **gases** or **dissolved substances** in solution from a region of high concentration to a region of low concentration when the two are in direct contact	**Osmosis** is the transport of **water** through a semi-permeable membrane from a solution of low concentration to a solution of high concentration	Active transport is the passage of salt or ions from its lower to higher concentration using energy from the cell through a living membrance.
2. **Liquids** and **gases** can diffuse over **considerable distances**.	**Water** only transported over a short distance.	Cell energy from ATP is needed for transpiration
3. Movement of the moecules of **solute** or **solvent.**	Movement of the moecules of **only water** as a solvent	Movement of ions only, other than water.
4. **Rapid** in **gases**, but slow in solutions.	**Slow** process	Rapid process.
5. Transport from **high** to **low** concentration along a **gradient**.	Transport of water from a solution of low concentration (more water molecules) to that of a **high** concentration (fewer water molecules.)	It is movement of molecules against a concentration gradient.
6. Occurs with or without a non-living **permeable** membrane.	Either a living or non-living **semi-permeable** membrane needed.	A living selective membrane is essential.

CHAPTER 3

ABSORPTION BY ROOTS

Syllabus

- *Absorption by roots, imbibition, diffusion and osmosis; osmotic pressure, root pressure; turgidity and flaccidity; plasmolysis and deplasmolysis; the absorption of water and minerals; active and passive transport (in brief); The rise of water up to the xylem; Forces responsible for ascent of sap.*
- *Transpiration - process and significance. Ganong's potometer and its limitations. The factors affecting rate of transpiration. Experiments on transpiration. A brief idea of guttation and bleeding.*

REVISION NOTES

Processes of Water and Mineral absorption

- **Introduction**
- Plant physiology is the branch of botany which deals with the study of metabolic activities or life processes of plants. Stephen Haler is considered as father of plant physiology. In India, Father of plant physiology is Sir. J.C. Bose.
- Water forms 66 % to 90 % of the total body weight of living beings.
- Gases, minerals and other solutes enter the plants and move from cell to cell.
- **Imbibition**
- **Imbibition** is the absorption of water by solid particles of an absorbent substance without forming a solution. e.g., swelling of seeds.
- Imbibition results in an increase in volume, liberation of heat and development of pressure called imbibition **pressure**.
- **Diffusion**
  - **Diffusion** is the movement of molecules of a substance (gas, liquid or solid) from the region of higher concentration to the region of lower concentration.
  - The diffusing particles create a certain pressure called diffusion pressure (DP) which is directly proportional to the number or concentration of diffusing particles.
  - The molecules move from higher DP to lower DP.
  - Diffusion is important for gaseous exchange of plants with atmosphere through **stomata and lenticels**.

Scan to know more about this topic

Osmosis and Diffusion

- **Tonicity**
  - Relative concentration of the solutions that determine the direction and extent of diffusion is called tonicity. Depending upon the tonicity, external solution may be:

(i) **Hypotonic:** If the external solution has low solute (or high solvent) concentration than the cell, then it is called a hypotonic solution or in other words, the solution is said to be more dilute than the cytoplasm of the cell.

(ii) **Isotonic:** If the external solution has a similar or solvent concentration as the cell, then it is called as isotonic solution.

(iii) **Hypertonic:** If the external solution has a high solute (or low solvent) concentration than the cell, then it is called a hypertonic solution or in other words, it is said to be more concentrated than the cytoplasm of the cell.

➢ **Osmosis**

- Osmosis is the movement of water from the region of higher chemical potential (dilute solution) to the region of its lower chemical potential (concentrated solution) when diffusion of solute is prevented by a semi-permeable membrane.
- In plants osmosis plays very important role in absorption of water and mineral salts from soil by roots. Osmosis can be of following two types, depending upon the concentration of the cell and the surrounding medium –

➢ **Endosmosis and Exosmosis**

- Endosmosis is the osmotic entry of water into a cell or system, when placed in pure water or **hypotonic solution**.
- Exosmosis is the osmotic withdrawal of water from a cell or system, when placed in a **hypertonic solution**.
- **Osmotic pressure** is a maximum pressure which can develop in a system due to osmotic entry of water into it under ideal conditions. Osmotic pressure is also defined as the pressure required to completely stop the entry of water into a osmotically active solution across a semipermeable membrane.
- **Root pressure** is a hydrostatic pressure. The cells of roots exert pressure due to which ascent of sap occurs. The force of root pressure is maximum in spring in tropical regions and minimum in summer.
- **Turgidity** is a condition of being fully distended due to endosmosis. Healthy plant cells are turgid and plants rely on turgidity to maintain rigidity.
- **Flaccidity** is a condition of absence of turgidity in which cell looses water from its cytoplasm due to exosmosis. Such cell is known as flaccid cell. e.g., wilting property of leaves when plant is exposed to the sun.
- **Plasmolysis** is the shrinkage of protoplast from the cell wall due to exosmosis caused by hypertonic solution. Permanent plasmolysis causes death.
- **Deplasmolysis** is when a plasmolysed cell is kept in water or hypotonic solution. Water enters the cell due to endosmosis.

Absorption, Characteristics of Root and Ascent of Sap

➢ **Absorption of Water**

- **Absorption** of water and minerals by plants mainly occur through roots. The maximum absorption takes place through root hairs located in the root hair zone lying just behind the root cap.
- There are two distinct mechanisms of water absorption by plants – **Active absorption** and **Passive absorption**. These two mechanisms operate independently of each other.

➢ **Active absorption**

- **Active absorption** of the water involves the expenditure of metabolic energy (**ATP**) released through respiration.
- In this process the root cells play active role in the absorption of water.

➢ **Passive transport**

- **Passive absorption** is mainly due to transpiration, where the root cells do not play any active role, but they remain passive.
- This process does not require the expenditure of **metabolic energy**.
- Passive absorption of water accounts for about **98%** of total water **uptake** by a plant.

Scan to know more about this topic

Uptake & transport of minerals

➢ **Root Hairs**

- **Root hairs** play very important role in the absorption of water.
- These are tubular outgrowths of **epiblema cells** present just above the **zone of elongation**.
- Because of their narrow nature they can pass easily into **soil interspaces** where **capillary water** is available for absorption.
- Cell sap of central **vacuole** exerts an osmotic pressure for absorption of water.

Scan to know more about this topic

Ascent of sap

Ascent of Sap

- Upward transport of water to aerial parts along with the dissolved mineral salts from roots to the aerial parts against the downward pull of gravity is called **ascent of sap**.
- Ascent of sap takes place through xylem.
- Several theories has been put forward to explain the mechanism of ascent of sap. These are **Vital force theory, Root pressure theory, Capillary force theory** and **Cohesive force theory**. Today most of the workers believe in the Cohesion tension theory.

Cohesive force theory

- Cohesive force is the force created due to mutual attraction between water molecules.
- Due to transpiration, large quantity of water is lost. Water forms a continuous column in the xylem of the leaves to the xylem of the root. Due to cohesion, the water column does not break.
- Cohesion of water and transpiration pull theory was given by **Dixon and Jolly** (1894). It was further improved by Dixon in 1914.
- According to this theory, a tension (transpiration pull) is created in water in the xylem elements of leaves due to constant transpiration. This pulls water upto the top of the tree.
- The continuity of water column in the xylem is maintained due to cohesive and adhesive force of water. This theory is widely accepted.
- Ringing experiment shows that water and minerals reach to the top through xylem. ' Ringing means the removal of continuous band of tissue external to the xylem. Organic food accumulates above the ring and swelling takes place suggesting the downward movement of the solutes.

Transpiration

Introduction

- The loss of water in the form of water vapours from the aerial (living) parts of the plant is called **transpiration**.
- $CoCl_2$ paper method is used to compare the rates of transpiration. Moisture coming out from stomata turn blue $CoCl_2$ paper pink.

Types of Transpiration

- There are three types of transpiration stomatal, cuticular and lenticular
  - (a) **Stomatal transpiration:** occurs through stomata.
  - (b) **Cuticular transpiration:** occurs through cuticle of leaves and green herbaceous stems.
  - (c) **Lenticular transpiration:** occurs through lenticels present on woody stems.
- Ganong's Potometer method of measuring the transpiration is based on the assumption that the rate of absorption of water is approximately equal to the rate of transpiration.
- Transpiration is more rapid during day than night because stomata closes during night.

Scan to know more about this topic

Transpiration

Adaptations in Plants to Reduce Transpiration

- There are various adaptations in plants to reduce transpiration like:
  - (i) Leaves reduced to spines to reduce the surface area for transpiration.
  - (ii) Waxy leaf cuticle, which is impermeable to water and stops evaporation.
  - (iii) Reduced number of stomata which reduces the transpiration rate.
- Many arid climate plants have specialized form of photosynthesis, which is called CAM photosynthesis.
- In these plants, the stomata remain shut during the day to reduce evaporation but open at night to collect carbon dioxide.
- Many chemicals (anti-transpirants) have been found to reduce the rate of transpiration without affecting CO_2 update, e.g. Phenyl mercuric acetate (a fungicide), abscisic acid (ABA) and CO_2. Silicon emulsion and low viscosity waxes cover stomata as a film, allow CO_2 & O_2 exchange but resist diffusion of water.

Guttation and Bleeding

- Guttation is the loss of water in the form of liquid drops. It usually occurs due to root pressure.
- Bleeding is the exudation of sap or watery solution from the cut or injured parts of the plants.

MNEMONICS

Concept : Types of Solutions

Mnemonics : Hand in Hand

Interpretation:
Hypertonic, Isotonic and Hypotonic solutions

Concept: Pathway of water absorption in plants

Mnemonics : RECEP to R X (receptor X)

Interpretation:
Root hair, Epidermis, Cortex, Endodermis, Pericycle to Root Xylem.

Concept: Environmental Factor affecting Transpirat

Mnemonics: Let's Work Together in HomeWork

Interpretation:
Light, Wind, Temperature, Humidity and Water availability.

KNOW THE TERMS

- **Apoplast pathway:** It is the movement of water through cell wall of plant cells without crossing any membrane.
- **Symplast pathway:** It is the movement of water through network of cytoplasm of cells which is interconnected by plasmodesmata.
- **Wall pressure:** It is the pressure exerted by the cell wall on protoplast of turgid cell.
- **Impermeable membrane:** It is the membrane which does not permit the solvent and solute molecules to pass through it.
- **Semi permeable membrane:** It is the membrane which permits only solvent molecules to pass through it.
- **Permeable membrane:** It is the membrane which allows both solvent and solute molecules to pass through it.
- **Transpiration:** It is the loss of water from the living aerial parts of plant.
- **Guttation:** It is the exudation of water from hydathodes present at vein endings.
- **Water potential:** It is the potential energy of water.
- **Ascent of sap:** It is a process of rising up of water and minerals from roots to tip of leaves through xylem.
- **Wilting:** It is the dehydration of leaf cells which results in the closure of stomata.

MULTIPLE CHOICE QUESTIONS

STAND ALONE MCQs

AI Q. 1. Diffusion

(A) The movement of molecules of a substance from the region of higher concentration to the region of lower concentration.

(B) The movement of molecules of a substance from the region of lower concentration to the region of higher concentration.

(C) The movement of molecules of a substance from the region of higher concentration to the region of lower concentration through semi permeable membrane.

(D) The movement of molecules of a substance within same concentration.

Ans. Option (A) is correct.

Explanation: Diffusion is the process of movement of molecules under a concentration gradient. The molecules move from a region of higher concentration to a region of lower concentration until the concentration becomes equal throughout.

Q. 2. Plasmolysis

(A) The phenomena of contraction of cytoplasm from the cell organelles.

(B) The phenomena of contraction of cytoplasm from the nuclear membrane

(C) The phenomena of contraction of cytoplasm from the cell wall.

(D) The phenomena of contraction of cytoplasm from the cell membrane.

Ans. Option (C) is correct.

Explanation: Plasmolysis is the shrinkage of protoplast from the cell wall due to exosmosis caused by hypertonic solution. Permanent plasmolysis causes death.

Q. 3. Turgidity

(A) A condition of being fully distended due to exosmosis.

(B) A condition of being fully distended due to endosmosis.

(C) A condition of being fully distended due to plasmolysis.

(D) A condition of being fully distended due to diffusion.

Ans. Option (B) is correct.

Explanation: Turgidity is a condition of being fully distended due to endosmosis. Healthy plant cells are turgid and plants rely on turgidity to maintain rigidity.

Q. 4. Bleeding

(A) Exudation of cell sap from any injured or cut part of a older tree.

(B) Exudation of cell sap from any injured or cut part of a plant.

(C) Exudation of cell sap from leaf margin of a plant.

(D) Exudation of cell sap from any aerial part of a plant.

Ans. Option (B) is correct.

Explanation: Bleeding is the exudation of sap or watery solution from any cut or injured parts of the plants due to increased root pressure.

State the exact location of the following:

Q. 1. Hydathodes

(A) Root tip (B) Nodes of stem

(C) Leaf margin and tip (D) Flowering bud

Ans. Option (C) is correct.

Explanation: Hydathodes are the structures involved in the guttation process that occurs in the plants. These are located at the margins of the leaves.

Q. 2. Lenticels

(A) On the bark of the older woody stem

(B) On the leaf of the older woody stem

(C) On the bark of the young stem

(D) On the nodes of the older woody stem

Ans. Option (A) is correct.

Explanation: Lenticels are open pores present on barks of stems of older woody plants.

Q. 3. Stomata

(A) Root hair (B) Internode of stem

(C) Surface of leaves (D) Flower petals

Ans. Option (C) is correct.

Explanation: Stomata are found on either both sides or on just one side of the leaf. They are found on the epidermis of leaves

Q. 4. Epiblema

(A) Root cells (B) Stem cells

(C) Leaf cells (D) Flower

Ans. Option (A) is correct.

Explanation: Epiblema is the mostly outermost unilayered region with various unicellular root hairs

State the function of the following:

AI Q. 1. Semi permeable membrane

(A) Allow some molecules to pass through while blocking the passage of water.

(B) Allow some molecules to pass through while blocking the passage of other molecules.

(C) Allow water molecules to pass through while blocking the passage of other molecules.

(D) Allow all molecules to pass through.

Ans. Option (B) is correct.

Explanation: A semi-permeable membrane is a barrier that will only allow some molecules to pass through while blocking the passage of other molecules.

Q. 2. Lenticel

(A) They allow diffusion of gases for respiration only.

(B) They allow diffusion of gases for photosynthesis only.

(C) They allow diffusion of water molecules for respiration and photosynthesis.

(D) They allow diffusion of gases for respiration and photosynthesis.

Ans. Option (D) is correct.

Explanation: Lenticels help in facilitating the process of transpiration in woody plants through diffusion. They allow diffusion of gases for respiration and photosynthesis

Q. 3. Hydathodes

(A) Help in guttation

(B) Help in transpiration

(C) Helps in respiration

(D) Helps in photosynthesis

Ans. Option (A) is correct.

Explanation: Guttation can occur through specialized openings present on the margins of the leaves that are known as hydathodes.

Q. 4. Stomata

(A) For exudation

(B) For removal of cell sap

(C) For gaseous exchange

(D) For photosythesis

Ans. Option (C) is correct.

Explanation: Stomata are the structures mainly responsible for the gaseous exchange in the process of photosynthesis, respiration and transpiration.

Q. 5. Sea fish when put in the tap water may bursts due to

(A) Endosmosis (B) Exosmosis
(C) Plasmolysis (D) Diffusion

Ans. Option (A) is correct.

Explanation: The sea fish that is used to salt water that has high salt content (solutes) and the freshwater is devoid of solutes. As a result, when you place a sea fish in freshwater, the freshwater will move into the cells. This will cause them to swell and burst (become turgid).

AI **Q. 6.** Choose the correct answer from each of the four options given below.

A plant cell can rupture if:

(A) Wall pressure equalizes turgor pressure.
(B) Turgor pressure exceeds wall pressure.
(C) Wall pressure exceeds osmotic pressure.
(D) Turgor pressure equalizes wall pressure.

Ans. Option (B) is correct.

Explanation: Turgor pressure helps to maintain the shape of the cell. Wall pressure of the cell is always equals to the turgor pressure. When the turgor pressure will exceeds the wall pressure the cell will burst.

Q. 7. What will be the condition of a plant cell when placed in hypotonicsolution?

(A) Endosmosis will takes place
(B) Exosmosis will take place
(C) Deplasmolysis will take place
(D) No change in condition of plant cell.

Ans. Option (A) is correct.

Explanation: Endosmosis is the osmotic entry of water into a cell or system, when placed in pure water or hypotonic solution.

Q. 8. Give the biological term of the process of mixing of two different substances / molecules of different concentrations.

(A) Plasmolysis (B) Deplasmolysis
(C) Osmosis (D) Diffusion

Ans. Option (D) is correct.

Explanation: Diffusion is the movement of molecules of a substance (gas, liquid or solid) from the region of higher concentration to the region of lower concentration.

Q. 9. Name the phenomenon by which living or dead plant cells absorb water by surface attraction.

(A) Diffusion (B) Osmosis
(C) Imbibition (D) Plasmolysis

Ans. Option (C) is correct.

Explanation: Imbibition is the absorption of water by solid particles of an absorbent substance without forming a solution.

Q. 10. Which part of the plant transports water from the soil to other parts of the plant?

(A) Cortex (B) Phloem
(C) Xylem (D) Root hair

Ans. Option (C) is correct.

Explanation: In plants, Xylem tissue transports water absorbed through roots to all parts of the plant.

Q. 11. The cells of roots exert pressure due to which ascent of sap occurs is called

(A) Turgor pressure (B) Osmotic pressure
(C) Root pressure (D) Wall pressure

Ans. Option (C) is correct.

Explanation: Root pressure is a hydrostatic pressure. It is pressure generated by the cortical cells of the root that pushes the water and minerals into the xylem vessels for the upward conduction up to the stem level.

Q. 12. A isotonic solution is:

(A) If the external solution has low solute (or high solvent) concentration than the cell.
(B) If the external solution has a similar or solvent concentration as the cell.
(C) If the external solution has a high solute (or low solvent) concentration than the cell.
(D) If the external solution has no solute present in it (pure water).

Ans. Option (B) is correct.

Explanation: A solution that has exactly the same water concentration with respect to another solution is called isotonic solution. In an isotonic solution, the extracellular fluid has the same osmolarity as the cell.

Q. 13. Diffusion in plants takes place through:

(A) Stomata (B) Lenticels
(C) Both of the above (D) None of these

Ans. Option (C) is correct.

Explanation: Diffusion is important for gaseous exchange of plants with atmosphere through stomata and lenticels. Stomata are mainly present on the surface of the leaves apart from the epidermal surface of young stem. Lenticels are open pores present on stems of woody plants.

AI **Q. 14.** Plasma membrane of plant cell is:

(A) Non permeable (B) Semi permeable
(C) Permeable (D) Selective permeable

Ans. Option (D) is correct.

Explanation: Plasma membrane is selective permeable membrane or differentially permeable membrane which allows the passage of molecules selectively.

Q. 15. Which of the following part of plant does not involve in pathway of water absorption?

(A) Phloem (B) Xylem
(C) Epidermis (D) Cortex

Ans. Option (A) is correct.

Explanation: Phloem transports organic food made in leaves to storage organs of the plant. It does not involve in water transportation in plants.

Q. 16. What is the name of the process given to the uptake of minerals ions against the concentration gradient?

(A) Active transport (B) Passive Transport
(C) Diffusion (D) Osmosis

Ans. Option (A) is correct.

Explanation: Active transport involves molecules moving against a gradient from an area of lower to higher concentration. It involves the expenditure of metabolic energy (ATP) released through respiration.

AI Q. 17. Which of the following has correct logical sequence for transportation of water in plants?

(A) Root hair, Endodermis, Epidermis, Xylem, Cortex.
(B) Endodermis, cortex, soil water, xylem, root hair.
(C) Soil water, root hair, cells of cortex, epidermis, xylem.
(D) Root hair, epidermis, cortex, endodermis, xylem.

Ans. Option (D) is correct.

Explanation: Water enters the root hair from the soil by the process of endosmosis. The water goes to epidermis and then passes through cortical cells by cell to cell osmosis and reaches the xylem of the root through endodermis.

Q. 18. Healthy plant cells are

(A) Turgid (B) flaccid
(C) Swollen (D) Dry

Ans. Option (A) is correct.

Explanation: Turgidity is a condition of being fully distended due to endosmosis. Healthy plant cells are turgid and plants rely on turgidity to maintain rigidity.

Q. 19. State the main function of the lenticels.

(A) They allow diffusion of gases for respiration and photosynthesis.
(B) They help in water transport
(C) They provide nutrition to the plant
(D) They are supportive structure of root

Ans. Option (A) is correct.

Explanation: Lenticels are pores, providing a pathway for the direct exchange of gases between the internal tissues and atmosphere through the bark, which is otherwise impermeable to gases.

Q. 20. Identify the odd one from the following terms

(A) Transpiration (B) Photosynthesis
(C) Phagocytosis (D) Guttation

Ans. Option (C) is correct.

Explanation: Transpiration, photosynthesis and guttation are physiological processes of plant but phagocytosis is a process found in animal cells.

Q. 21. Which of the following is the exact location of the hydathodes?

(A) Tip and margins of leaf.
(B) Stem and branches
(C) Node of stem
(D) All aerial part of plant.

Ans. Option (A) is correct.

Explanation: A hydathode is a type of pore found in plants. It secretes water through pores in the epidermis or leaf margin, typically at the tip of a margin.

AI Q. 22. Which one of the following structure in plants remains open always:

(A) Stomata (B) Lenticels
(C) Both (D) None of these

Ans. Option (B) is correct.

Explanation: Lenticels always remain open irrespective of day and night or any other biological factor. But stomatal opening and closing is related to various biological factors.

Q. 23. The biological term for the exudation of sap from injured parts of a plant is

(A) Guttation (B) Exudation
(C) Transpiration (D) Bleeding

Ans. Option (D) is correct.

Explanation: The exudation of water and cell sap through the cuts or wound of plants is called as bleeding.

Q. 24. The loss of water in the form of water vapours from the aerial (living) parts of the plant is called

(A) Ascent of sap (B) Evaporation
(C) Respiration (D) Transpiration

Ans. Option (D) is correct.

Explanation: Transpiration is the process by which aerial part of the plant (mainly leaves) looses water in the form of water vapour.

Q. 25. In transpiration , water leaves plants in form of

(A) Dew (B) Vapours
(C) Mist (D) Sap

Ans. Option (B) is correct.

Explanation: Transpiration is the process by which aerial part of the plant (mainly leaves) looses water in the form of water vapour.

Q. 26. Which of the following process occurring in leaves lowers the temperature of plant?

(A) Guttation (B) Respiration
(C) Photosythesis (D) Transpiration

Ans. Option (D) is correct.

Explanation: Transpiration cools the plant as in this process loss of water change into vapour and this causing cooling effect.

Q. 27. Old woody plants transpire through:

(A) Bark (B) Stomata
(C) Lenticels (D) Root

Ans. Option (C) is correct.

Explanation: Lenticels help in facilitating the process of transpiration in woody plants.

Q. 28. Location of stomata in plant:

(A) Root hair (B) Internode of stem
(C) Surface of leaves (D) Flower petals

Ans. Option (C) is correct.

Explanation: Stomata are found on either both sides or on just one side of the leaf. They are found on the epidermis of leaves

ASSERTION AND REASON MCQs

Directions: In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both (A) and (R) are true, and (R) is the correct explanation of (A).
(B) Both (A) and (R) are true, but (R) is not the correct explanation of (A).
(C) (A) is true, but (R) is false.
(D) (A) is false, but (R) is true.

AI Q. 1. **Assertion (A):** Root hairs become flaccid and droop when excess fertilizers are added to the moist soil around them.

Reason (R): Formation of hypertonic solution which results in plasmolysis / exosmosis.

Ans. Option (A) is correct.

Explanation: Fertilizer along with soil water acts as a hypertonic solution. This leads to exosmosis, i.e. movement of water from plant. Thus, the plant begins to die.

Q. 2. **Assertion (A):** Potato cubes when placed in water become firm and increase in size.

Reason (R): Potato tuber cells have very high absorbing capacity.

Ans. Option (C) is correct.

Explanation: This happens because water acts as a hypotonic medium, thus water enters into potato cells due to endosmosis making them firm and larger in size.

Q. 3. **Assertion (A):** High concentration of salt is added to pickles.

Reason (R): It allows pickle to be preserved for long duration.

Ans. Option (A) is correct.

Explanation: Salt is added to pickles as it provides hypertonic medium due to which water molecules moves out of the cell by the mechanism of plasmolysis. This allows pickle to be preserved for long duration.

Q. 4. **Assertion (A):** Sugar solution is hypertonic in nature.

Reason (R): It is less concentrated than water.

Ans. Option (C) is correct.

Explanation: If the external solution has a high solute (or low solvent) concentration than the cell, then it is called a hypertonic solution. Sugar solution is hypertonic in nature as it is more concentrated than water.

Q. 5. **Assertion (A):** Wooden frames of doors get jammed during monsoon season.

Reason (R): Wooden frames of doors get jammed during monsoon season due to the process of imbibition.

Ans. Option (A) is correct.

Explanation: In this process, water is adsorbed to the surface of hydrophilic colloids. As wood has strong affinity for water, they absorb water from their surroundings and get swelled up.

AI Q. 6. **Assertion (A):** Wall pressure is pressure exerted by wall on cell membrane.

Reason (R): Wall pressure is because of the negative osmotic potential of the vacuolar solution.

Ans. Option (D) is correct.

Explanation: Wall pressure is the pressure exerted by the cell wall on protoplast of turgid cell.

Q. 7. **Assertion (A):** Wilting of leaves occurs when plant is exposed to the sun.

Reason (R): The leaf cells contain stomatal opening.

Ans. Option (B) is correct.

Explanation: Flaccidity is a condition of absence of turgidity in which cell looses water from its cytoplasm due to exosmosis. Such cell is known as flaccid cell, e.g., wilting of leaves occurs when plant is exposed to the sun.

Alok

Q. 8. **Assertion (A):** Root hairs play very important role in the absorption of water.

Reason (R): Because of their narrow nature they can pass easily into soil interspaces where capillary water is available for absorption.

Ans. Option (A) is correct.

> *Explanation:* Root hairs are tubular outgrowths of epiblema cells present just above the zone of elongation. Cell sap of central vacuole exerts an osmotic pressure for absorption of water.

AI Q. 9. **Assertion (A): The upward movement of water is called ascent of sap.**

Reason (R): Ascent of sap takes place through xylem.

Ans. Option (A) is correct.

> *Explanation:* Upward transport of water to aerial parts along with the dissolved mineral salts from roots to the aerial parts against the downward pull of gravity is called ascent of sap. Due to transpiration, large quantity of water is lost. Water forms a continuous column in the xylem of the leaves to the xylem of the root.

Q. 10. **Assertion (A):** The diffusing particles create a certain pressure called diffusion pressure.

Reason (R): Diffusion pressure is directly proportional to the number or concentration of diffusing particles.

Ans. Option (B) is correct.

> *Explanation:* The pressure exerted by molecules (i.e., gases, liquids or solids) with the tendency to diffuse from the region of their higher concentration to the region of their lower concentration is known as diffusion pressure.

Q. 11. **Assertion (A):** Balsam plants wilt during mid day even if the soil is well watered.

Reason (R): The rate of transpiration is more in mid day.

Ans. Option (A) is correct.

> *Explanation:* Balsam plants wilt during mid day even if the soil is well watered because the rate of transpiration is more than the rate of absorption of water as the intensity of light and temperature is high during mid-day.

AI Q. 12. **Assertion (A):** Herbaceous plants growing in well-watered soils are found to wilt on a hot day.

Reason (R): It is the dehydration of leaf cells which results in the closure of stomata.

Ans. Option (B) is correct.

> *Explanation:* On a hot day, the stomata are fully open and the rate of transpiration is more than the rate of absorption. This leads to wilting in them.

Q. 13. **Assertion (A):** Transpiration can occur through all parts of the leaf.

Reason (R): Stomata are more or less evenly distributed on the epidermis.

Ans. Option (A) is correct.

> *Explanation:* Stomatal transpiration is the most important form of transpiration. Stomata are specialised openings present on the epidermal cells of leaf.

Q. 14. **Assertion (A):** Transpiration occurs only when stomata are open.

Reason (R): Transpiration takes place through stomata only.

Ans. Option (C) is correct.

> *Explanation:* Though most of the transpiration process takes place through stomata, it also takes place through cuticles and lenticels.

Q. 15. **Assertion (A):** Humidity has no effect on the rate of transpiration.

Reason (R): Atmosphere has specific relative humidity which affects the plants.

Ans. Option (D) is correct.

> *Explanation:* Rate of transpiration is inversely proportional to the relative humidity. The higher the humidity, the lower is the rate of transpiration and vice versa.

Q. 16. **Assertion (A):** Fog affects the transpiration.

Reason (R): It decreases the rate of transpiration.

Ans. Option (A) is correct.

> *Explanation:* On a foggy day, the rate of transpiration decreases because of high atmospheric moisture (humidity) which lowers the rate of transpiration.

Q. 17. **Assertion (A):** Bleeding is necessary process for plant.

Reason (R): Bleeding is the exudation of cell sap from any injured or cut part of a plant, due to increased root pressure.

Ans. Option (D) is correct.

> *Explanation:* Bleeding is not a necessary process. It doesn't have any role in plant growth. It occurs due to injury in plants.

AI Q. 18. **Assertion (A):** The leaves of certain plants roll upon a bright sunny day.

Reason (R): Due to transpiration they lost their turgidity.

Ans. Option (A) is correct.

> *Explanation:* On a bright sunny day, the cells of the leaves losses water due to transpiration and thus lose their turgidity. This causes the leaves to roll up and thus reduce transpiration.

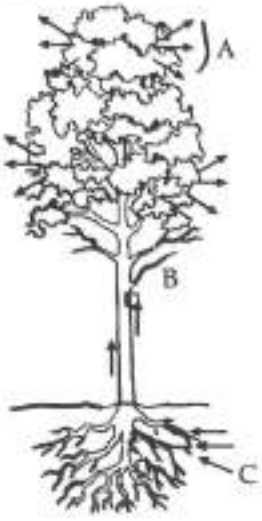
Q. 19. Assertion (A): Lenticels are present on bark old woody stems.
Reason (R): Lenticels are rarely open.
Ans. Option (C) is correct.

Explanation: Lenticel is the biological term used for the permanently open structure seen on the bark of an old woody stem.

CASE-BASED MCQs

Picture Based Questions

I. An outline sketch of a tree is shown in the diagram below. Study the same and answer the questions from Q1 to Q5.



Q. 1. Name the phenomenon that is labelled A in the diagram.
(A) Photosynthesis (B) Guttation
(C) Bleeding (D) Tranpiration
Ans. Option (D) is correct.

Explanation: Transpiration is the loss of water in the form of vapours from the aerial parts of plant.

Q. 2. What does arrow B indicates?
(A) Translocation of water
(B) Growth of the tree
(C) Height of the tree
(D) Thickness of stem
Ans. Option (A) is correct.

Explanation: Water absorbed by roots is translocated to all aerial parts of the tree. It is very important for the growth of the plant.

Q. 3. Which process does arrow C indicates in relevance to the diagram?
(A) Photosynthesis
(B) Root respiration
(C) Absorption of water by roots
(D) Translocation of sucrose
Ans. Option (C) is correct.

Explanation: One of the most important functions is of root is to absorb water and minerals from soil and passes to the plant for the growth. In this diagram absorption of water by roots is more relevant as it is directly related to rate of transpiration.

Q. 4. What is the importance of phenomenon shown by A in plants?
(A) It helps in upward movement of water and minerals from the plant.
(B) It controls the rate of water being absorbed by the roots.
(C) Both of the above
(D) None of the above
Ans. Option (C) is correct.

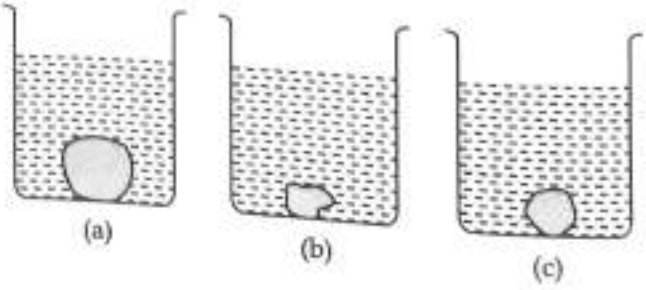
Explanation: Transpiration plays important role in plant growth. It helps in cooling the plant and pumping water and minerals to the leaves for photosynthesis. It also controls the rate of water being absorbed by the roots.

Q. 5. A factor that will increase the rate of the phenomenon shown by A:
(A) Wind velocity (B) Height of plant
(C) Age of plant (D) Soil minerals
Ans. Option (A) is correct.

Explanation: On a windy day, the rate of transpiration increases because of moving wind which removes the water vapours from around the leaves.

II. Read the paragraph carefully. Answer any four questions from Q1 to Q5.

A candidate in order to study the process of osmosis has taken 3 potato cubes and put them in 3 different beakers containing 3 different solutions. After 24 hours, in the first beaker the potato cube increased in size, in the second beaker the potato cube decreased in size and in the third beaker there was no change in the size of the potato cube. The following diagram shows the result of the same experiment.



ABSORPTION BY ROOTS

Q. 1. What are the technical terms of the solutions used in beakers, a, b and c?

(A) (a) Hypotonic solution (b) Hypertonic solution (c) Isotonic solution

(B) (a) Hypertonic solution (b) Hypotonic solution (c) Isotonic solution

(C) (a) Hypertonic solution (b) Isotonic solution (c) Hypotonic solution

(D) (a) Isotonic solution (b) Hypertonic solution (c) Hypotonic solution

Ans. Option (A) is correct.

Explanation: Endosmosis is the osmotic entry of water into a cell or system, when placed in pure water or hypotonic solution. Exosmosis is the osmotic withdrawal of water from a cell or system, when placed in a hypertonic solution.

Q. 2. In beaker c, the size of the potato cube remains the same because

(A) No translocation (B) No diffusion

(C) No imbibition (D) No osmosis

Ans. Option (D) is correct.

Explanation: In beaker c, there is no difference in concentration of solution and in the concentration of cell sap. So there is no movement of water molecules / No osmosis.

Q. 3. How does a cell wall and a cell membrane differ in their permeability?

(A) Cell wall - Freely permeable. Cell membrane – Selectively permeable.

(B) Cell wall - Non permeable. Cell membrane – Freely permeable.

(C) Cell wall – Semi permeable. Cell membrane – Non permeable.

(D) Cell wall - Freely permeable. Cell membrane – Selectively permeable.

Ans. Option (A) is correct.

Explanation: Cell wall of plants is freely permeable to solute as well as solvent. It allows all to pass through it. However cell membrane is highly selective in permeability. It allows only selective solutes to pass through it.

Q. 4. What is the specific feature of the cell sap of root hairs which helps in absorption of water?

(A) Diluted cell sap (B) Isotonic cell sap

(C) Concentrated cell sap (D) None of these

Ans. Option (C) is correct.

Explanation: The cells of the roots contain cell sap (solution) at a higher concentration than that of surrounding soil water. As a result, the water is absorbed by the root hairs.

Q. 5. Osmosis is

(A) The movement of water / solvent molecules from the region of it's higher concentration to the region of lower concentration across a impermeable membrane.

(B) The movement of water / solvent molecules from the region of it's higher concentration to the region of lower concentration across a semi-permeable membrane.

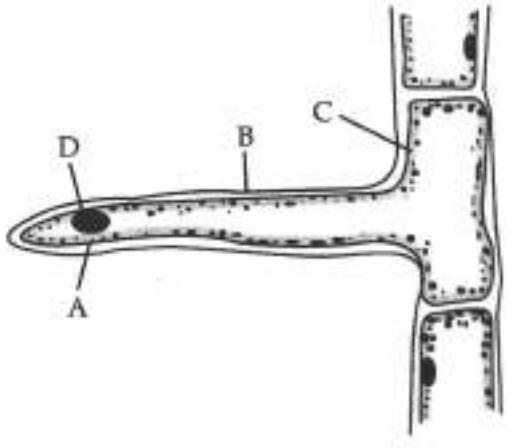
(C) The movement of water / solvent molecules from the region of it's lower concentration to the region of higher concentration across a freely permeable membrane.

(D) The movement of water / solvent molecules from the region of it's higher concentration to the region of higher concentration across a semi-permeable membrane.

Ans. Option (B) is correct.

Explanation: Osmosis is the spontaneous net movement or diffusion of solvent molecules through a semi permeable membrane from a region of high water potential to a region of low water potential, in the direction that tends to equalize the solute concentrations on the two sides.

AI III. The diagram alongside represents a layer of epidermal cells showing a fully grown root hair. Study the diagram and answer any four questions from Q1 to Q5.



Q. 1. Name the parts Labelled as A and B.

(A) A- Cell wall, B – cell membrane

(B) A- Cell membrane, B – cell wall

(C) A- Cell nucleus, B – cell membrane

(D) A- Cell wall, B – cell cytoplasm.

Ans. Option (A) is correct.

Explanation: The outer most layer of root hair has cell wall and next to it is cell membrane.

Q. 2. The root hair cell is in a turgid state. Which process is responsible for this state?

(A) Exomosis (B) Translocation
(C) Imbibition (D) Endosmosis

Ans. Option (D) is correct.

> ***Explanation:*** The soil medium is hypotonic, thus, endosmosis occurs and leads to turgid condition of the root hair cell.

Q. 3. Which pressure is exerted by cells of roots that helps in water movement?

(A) Wall pressure (B) No pressure
(C) Root pressure (D) Turgor pressure

Ans. Option (C) is correct.

> ***Explanation:*** The pressure generated by the cortical cells of the root that pushes the water and minerals into the xylem vessels for the upward conduction upto the stem level is known as root pressure.

Q. 4. What will happen to root hairs if an excess of fertilizer is added to the soil close to it?

(A) They become turgid
(B) They become swollen
(C) They become flaccid
(D) No change will occur

Ans. Option (C) is correct.

> ***Explanation:*** Root hairs become flaccid and droop when excess fertilizers are added to the moist soil around them. Formation of hypertonic solution results in plasmolysis/ exosmosis.

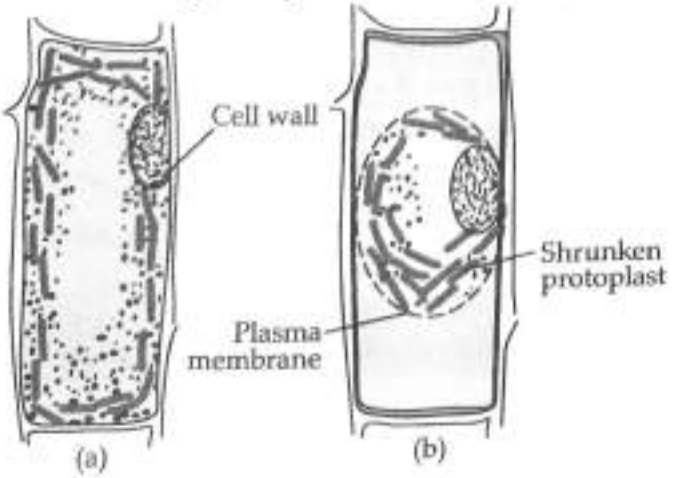
Q. 5. Cell sap is present in:

(A) Cell wall (B) Cell cytoplasm
(C) Cell chloroplast (D) Cell vacuole

Ans. Option (D) is correct.

> ***Explanation:*** Cell sap is a fluid found in the vacuoles (small cavities) of the living cell; it contains variable amounts of food and waste materials, inorganic salts, and nitrogenous compounds.

IV. Given below are diagrams of different cells as seen under the microscope after having been placed in two different solutions. Study the diagram and answer any four questions from Q1 to Q5.



Q. 1. What is the technical term for the condition of Cell (a) and cell (b).

(A) a- turgid cell, b- flaccid cell
(B) a – flaccid cell, b – turgid cell
(C) Both are flaccid cells
(D) Both are turgid cell.

Ans. Option (A) is correct.

> ***Explanation:*** Shrunken protoplast indicates flaccidity of the cell due to plasmolysis.

Q. 2. From the solution given in the brackets (water, strong sugar solution), name the solution into which cell (a) and cell (b) were placed before being viewed under the microscope.

(A) Both cells in water
(B) Both cells in sugar solution
(C) a- sugar solution, b- water
(D) b- water, b- sugar solution

Ans. Option (D) is correct.

> ***Explanation:*** Water acting as isotonic solution for cell does not cause any change to the cell. Sugar solution act as hypertonic solution for the cell causes shrinkage of protoplasm due to plasmolysis.

Q. 3. Give the scientific term for the recovery of the cell b.

(A) Plasmolysis (B) Deplasmolysis
(C) Turgidity (D) Flaccidity

Ans. Option (B) is correct.

> ***Explanation:*** Deplasmolysis occurs when a plasmolysed cell is kept in water or hypotonic solution. Water enters the cell due to endosmosis.

Q. 4. Which type of cells is shown in diagram?

(A) Animal cell (B) Plant cell
(C) Bacterial cell (D) None of these

Ans. Option (B) is correct.

> ***Explanation:*** Presence of cell wall and nucleus indicates the given cells are of plant.

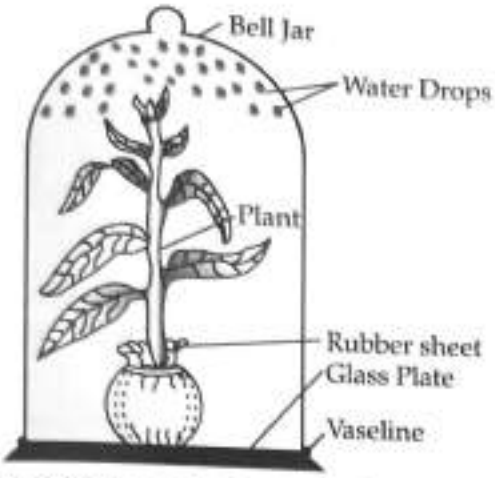
Q. 5. The central cavity like structure in plant cell represents:

(A) Cell hole (B) Cell cytoplasm
(C) Cell vacuole (D) Cell protoplasm

Ans. Option (C) is correct.

> ***Explanation:*** A Plant cell contains central vacuole which has cell sap.

AI **V. Given below is an apparatus which was setup to investigate a physiological process in plants. The set up was kept in sunlight for two hours. Droplets of water were then seen inside the bell jar. Observe carefully and answer any four questions from Q1 to Q5.**



Q. 1. Name the process being studied.

(A) Guttation (B) Bleeding
(C) Respiration (D) Transpiration

Ans. Option (D) is correct.

> ***Explanation:*** Bell jar is used to study the process of transpiration .It is the loss of water from the living aerial parts of plant. Bell jar traps these water vapours on its surface.

Q. 2. Why was the pot enclosed in a rubber sheet?

(A) To prevent evaporation of water from the pot/ soil.

(B) To prevent respiration of water from the pot/ soil.

(C) To improve the quality of soil.

(D) To stop transpiration process.

Ans. Option (A) is correct.

> ***Explanation:*** Soil and pot contain certain amount of water or moisture which may evaporates after sometimes. In order to stop evaporation from pot/ soil rubber sheet is used. This will not interfere with the main aim of experiment.

Q. 3. Why water droplets appeared on the inner surface of bell jar?

(A) It comes from environment.

(B) It comes from soil of pot.

(C) It appeared due to transpiration from plants

(D) It appeared due to guttation in plants.

Ans. Option (C) is correct.

> ***Explanation:*** After 2 hours in sunlight, plant aerial parts starts transpiration process. Since there is no escape of water vapour from bell jar , they get settle down on the surface of bell jar and appear as water droplets.

Q. 4. Why Vaseline is applied on the edge of bell jar?

(A) To prevent respiration process

(B) To prevent escape of water vapour

(C) To prevent entry of water.

(D) None of the above

Ans. Option (B) is correct.

> ***Explanation:*** Vaseline is used to seal the bell in order to prevent any escape of water vapour which is released by plant.

Q. 5. Why the whole set up is placed under sunlight?

(A) To increase the rate of transpiration.

(B) To initiate the process of respiration.

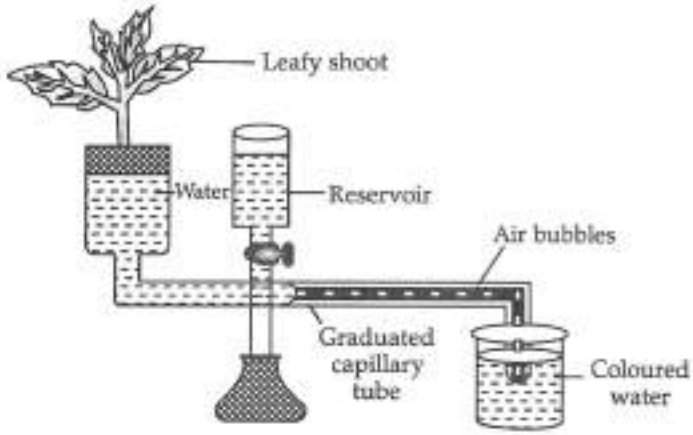
(C) To provide light to the observer

(D) To increase the rate of photosynthesis

Ans. Option (A) is correct.

> ***Explanation:*** Sunlight or light has effect on rate of transpiration. It increases temperature which ultimately increases the rate of transpiration. Also in light stomata remain open and transpiration takes place.

VI. The diagram of an apparatus given below demonstrates a particular process in plants. Study the same and answer any four questions from Q1. to Q5.



Q. 1. Name the apparatus shown in diagram.

(A) Respirometer (B) Photometer
(C) Potometer (D) Barometer

Ans. Option (C) is correct.

> ***Explanation:*** A potometer, sometimes known as transpirometer, is a apparatus used for measuring the rate of water uptake of a leafy shoot which is almost equal to the water lost through transpiration. This apparatus in diagram is Ganong's Potometer.

Q. 2. Which phenomenon is demonstrated by this apparatus?

(A) Respiration (B) Photosynthesis
(C) Bleeding (D) Transpiration

Ans. Option (D) is correct.

> ***Explanation:*** Ganong's Potometer is used to measure the rate of transpiration in terms of water uptake and water loss.

Q. 3. What is the importance of air bubble in the experiment?

(A) Helps to remove moisture.

(B) Helps to calculate the rate of transpiration in a given time.

(C) Helps in measuring length of water column.
(D) All of the above.

Ans. Option (B) is correct.

Explanation: The movement of air bubble in graduated capillary tube indicated the rate of uptake of water by plant twig. This helps to calculate the rate of transpiration.

Q. 4. What are/is limitations of using this apparatus?
(A) Introducing the air bubble is difficult
(B) Twig may not be alive for a long period.
(C) Changes in the outside temperature/light/ humidity affects the position of air bubble.
(D) All of the above

Ans. Option (D) is correct.

Explanation: The potometer does not measure the transpiration rate accurately. There are certain limitations of apparatus. All points mentioned are the limitations while calculation rate of transpiration.

Q. 5. Name the structure of the plant through which the demonstrating process takes place in the set up apparatus.
(A) Stomata
(B) Chloroplast
(C) Nucleus
(D) Hydathode

Ans. Option (A) is correct.

Explanation: Stomata are specialized pores in the leaves which help in the process of transpiration . They account for around 80% to 90% of the total water loss from the plants.

❐❐

Photosynthesis

Definition

It is the process by which living plant cells, containing chlorophyll, produce food substances (glucose and starch), from CO_2 and H_2O, by using light energy.

Reaction of Photosynthesis Equation

$6CO_2 + 12H_2O$ Show Chlorophyll and Light energy on arrow mark

$C_6H_{12}O_6 + 6H_2O + 6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}}$

$C_6H_{12}O_6 + 6O_2\uparrow$

Factors affecting photosynthesis

- External Factors
  - Water concentration
  - Temperature
  - CO_2 concentration
  - Light intensity
- Internal Factors
  - Chlorophyll
  - Protoplasm
  - Structure of leaf

Process

- Light-dependent phase (photo chemical phase)
- Light-independent phase (biosynthetic phase)

Importance of photosynthesis

- Food for all
- Oxygen to breathe in

Chlorophyll

It is the green pigment found in chloroplast

- Types of chlorophyll
  - Chl a
  - Chl b

Chloroplasts

They contain closely packed flattened sacs, thylakoids arranged in piles (grana) in stroma

Opening and closing of stomata

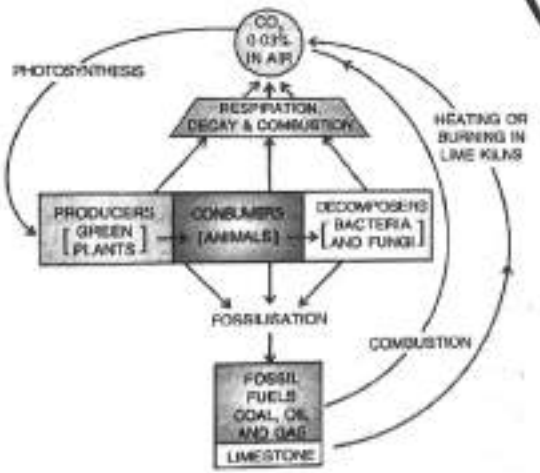
Two theories

- K^+ Concentration theory
- Sugar concentration theory

Adaptations in leaf to perform photosynthesis

- Large surface area
- Arrangement of chloroplast on the upper surface of leaves.
- Numerous stomata
- Thinness of leaves
- Concentration of chloroplast
- Extensive vein system

Carbon cycle



Trace the Mind Map

- First Level
- Second Level
- Third Level

CHAPTER 4

PHOTOSYNTHESIS

Syllabus

- ***Photosynthesis : The process importance to life in general; experiments to show the necessity of light, carbon dioxide, chlorophyll, formation of starch and release of oxygen.***

REVISION NOTES

Basics of Photosynthesis

- Photosynthesis is the process in which green plants or their parts produce complex carbon containing compounds with the help of inorganic raw materials such as CO_2 and water in the presence of sunlight. O_2 is liberated as the by-product.

$$6\,CO_2 + 12\,H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2\uparrow + 6\,H_2O$$

- The whole of the oxygen liberated comes from water, by a process called photolysis of water.
- This is an anabolic, endergonic (requires energy) and oxidation-reduction process. Photosynthesis is the only process by which solar energy is converted into chemical energy.
- **Chloroplast:** A **chloroplast** is an oval, minute, double membrane organelle present in green plants.
- It contains a green pigment called chlorophyll which absorbs light energy for photosynthesis.
- Internally it contains a matrix or **stroma** and the **thylakoids**.
- At some places the thylakoids arrange themselves to form a stack of coins like structure called **grana**.
- Each stack of thylakoid sacs are connected by a structure known as stromal lamellae.
- The chloroplast mainly occurs in chlorenchymatous cells of leaves.

Scan to know more about this topic

Chlorophyll and photosynthesis

- **Stomata**
  - Stomata are the structures mainly responsible for the gaseous exchange in the process of photosynthesis, respiration and transpiration.
  - Stomata open in light when guard cells are turgid and close when they are flaccid.
  - These turgor changes lead to the opening and closing of stomata.

Scan to know more about this topic

Mechanism of stomatal opening and closing

- **Mechanism of photosynthesis**
  - Photosynthesis consists of two stages – the light phase and the dark phase. In the light phase, light is absorbed and used by chlorophyll. This, therefore, is called the photochemical reaction or Hill's reaction. It can be described in two steps – Photolysis and formation of assimilatory powers.

- Photolysis is the process of splitting of water in the presence of light. Water splits into H^+ and OH^- ions. H^+ ions go to $NADP^+$ while OH^- ions form water, oxygen and electron in the presence of Z complex enzymes, Mn^{+2} and Cl^- ions.

$$4H_2O \rightarrow 4H^+ + 4OH^-$$

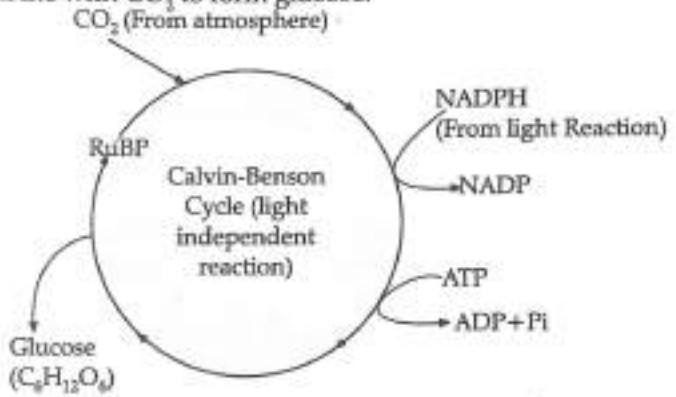
$$4OH^- \xrightarrow{Mn^{+2}, Cl^- \text{ Z complex}} 2H_2O + O_2 \uparrow + 4e^-$$

- Assimilatory powers [ATP and NADPH] are formed in non-cyclic photophosphorylation. These assimilatory powers are used in dark reaction. The assimilatory powers are for fixation of CO_2 into glucose.
- Photophosphorylation is the process in which ADP (Adenosine Diphosphate) is converted into ATP (Adenosine Triphosphate) by the addition of one phosphate (Pi) group, i.e inorganic phosphate, utilizing the energy from photons.

$$ADP + Pi \rightarrow ATP$$

➢ **Dark Phase:** Dark reaction (Biosynthetic phase) or Blackman's reaction involves the fixation and reduction of CO_2 resulting in the formation of carbohydrates.

- The dark phase occurs in the stroma of the chloroplast where all the enzyme necessary for CO_2 fixation and synthesis of sugar and starch are located.
- RuBP (Ribulose bisphosphate) acts as a primary acceptor of atmospheric CO_2 in the beginning of this phase and by the utilization of ATP and NADPH (products of light reaction), glucose is synthesized and RuBP is regenerated.
- The overall reaction of this phase is:
  $6\,RuBP + 6\,CO_2 + 18\,ATP + 12e^- \rightarrow 6\,RuBP + C_6H_{12}O_6 + 18\,ADP + 18\,Pi + 12\,NADP + 6H_2O$
- The hydrogen ions combine with CO_2 to form glucose.



- Glucose produced during photosynthesis is soluble in water and consists of small molecules.
- As soon as glucose is produced, it is converted into starch by the process of polymerisation.
- The starch is insoluble in water. It is stored in the parts of the plant for later use.

➢ **Adaptation of a leaf for photosynthesis**

- Large surface area to maximize light harvesting.
- Thinness of leaves to reduce distance for CO_2 to diffuse through the leaf and to ensure that light penetrates into the middle of the leaf.
- Arrangement of chloroplast on the upper surface of leaves so as to receive maximum amount of light.
- Presence of more stomata to allow rapid exchange of gases (CO_2 and O_2).

Scan to know more about this topic

Experiments to observe photosynthesis

Different Experiments and Factors Affecting Photosynthesis

➢ **Different Experiments on Photosynthesis**

- **Test for photosynthesis:** Leaf is killed in boiling water (5-10 minutes), dried, decolourised in warm spirit, moistened and dipped in iodine solution. Blue colour indicates starch.
- **CO_2 is necessary for photosynthesis/Moll's half experiment:** One half of destarched leaf is inserted in air tight wide mouthed bottle having small quantity of KOH (for absorption of CO_2) and illuminated. Starch test after one hour indicates absence of CO_2 in inserted half and presence in outer half (where CO_2 is available).
- **Light is necessary for photosynthesis** : Intact leaf of a destarched plant is fitted in Ganong's light screen with a designed cut in its lid. The same is exposed to light for some time and then tested for starch. Only the design through which light falls on the leaf becomes blue coloured.

Scan to know more about this topic

Importance of light in photosynthesis

- **Chlorophyll is essential for photosynthesis:** Illuminated variegated leaf of Coleus plant is tested for starch. Only those areas turn blue which had chlorophyll.

➢ **Factors affecting Photosynthesis**

External Factors

- **Light:** Photosynthesis is successfully accomplished in the visible light (380 – 760 nm wave-length) of the spectrum. Rate of photosynthesis is maximum in red light, average in blue light and minimum in green light. A moderate light intensity is favourable for high rate of photosynthesis.
- **Temperature :** Generally the photosynthesis increases with an increases in temperature in the range of 10-35°C. Beyond the 35°C, the rate of photosynthesis decreases.
- **Water:** About 1% total water absorbed is used in photosynthesis. Water deficiency reduces the rate of photosynthesis.

➢ **Internal Factors**

- **Chlorophyll:** It is essential for photosynthesis to occur. The rate of photosynthesis per unit of chlorophyll decreases with the age of leaf.
- **Accumulation of end product of photosynthesis:** The rate of photosynthesis falls with the accumulation of food synthesized by photosynthesis.

MNEMONICS

Concept : Photosynthesis Reaction	Concept : Factors Affecting Photosynthesis
Mnemonics : Cows Eat Wet Grass Outside	**Mnemonics : Let's Take Walk Candy!**
Interpretation: Carbon dioxide + Energy + Water → Glucose + Oxygen	**Interpretation:** Light, Temperature, Water, Carbon dioxide.

KNOW THE TERMS

- **Photo-oxidation:** The reaction of a substance with oxygen under the influence of light.
- **Accessory pigments:** These are the pigments other than chlorophyll present in photosystems which help in capturing light and passing it to the photocentres.
- **CAM plants:** These refers to the succulents and some other plants which show crassulacean acid metabolism.
- **Chemosynthesis:** The process of synthesis of food in which the organisms use chemical reactions to obtain energy from inorganic compounds.
- **Photocentre:** It is a primary pigment molecule in the photosystem where energy is used to derive chemical reactions.
- **Photorespiration:** It is a process which involves loss of fixed carbon as CO_2, in plants in the presence of light. This process does not produce ATP or NADPH and thus is a wasteful process.
- **Photosystem:** It is light harvesting system present in the thylakoids of chloroplast.
- **Photosynthetically Active Radiation (PAR):** It is visible spectrum of light between 400 nm to 700 nm.
- **Photolysis:** It is splitting of water molecules in the chloroplast in presence of light.
- **Translocation:** It is the process of movement of food from leaves to roots via phloem.
- **Autotrophs:** Organisms capable of synthesizing their required nutrients from simple inorganic compounds in the presence of solar energy and chlorophyll.
- **Heterotrophs:** An organism that cannot synthesize its own food and must feed on nutrients manufactured by autotrophs.
- **Fluorescence:** Emission of light, usually visible, of wave-length different from that absorbed from irradiated materials or from impact of electrons.
- **Phosphorescence:** It is delayed emission of long wave radiations by irradiate substances which continues for sometime after removal of irradiation source.
- **Reaction centres:** It is chlorophyll molecule which converts light energy into chemical energy by bringing about electrical charge separation. Thus, chlorophyll molecules act as reaction centres.
- **Phytol:** It is a carbon chain which is attached to porphyrin ring of chlorophyll like a tail. Chemically, phytol is $C_{20}H_{39}OH$.
- **Solarisation:** Destruction of chlorophyll due to high light intensity is called solarisation.
- **Compensation point:** The light intensity at which rate of photosynthesis is equal to the rate of respiration (in morning and evening).

Alok

MULTIPLE CHOICE QUESTIONS

STAND ALONE MCQs

Q. 1. Water Photolysis
(A) Splitting of water molecules in the mitochondria in presence of light.
(B) Splitting of water molecules in the chloroplast in absence of light.
(C) Splitting of water molecules in the chloroplast in presence of light.
(D) Transpiration of water molecule from the chloroplast in presence of light.

Ans. Option (C) is correct.

Explanation: Photolysis in photosynthesis is the splitting of water molecules into hydrogen ions and hydroxyl ions in the presence of chlorophyll and light.

Q. 2. Photophosphorylation
(A) The process of conversion of ATP into ADP during photosynthesis.
(B) The process of conversion of ADP into ATP during photosynthesis.
(C) The process of conversion of ADP into ATP Turing respiration.
(D) The process of conversion of ATP into ADP during respiration.

Ans. Option (B) is correct.

Explanation: Photophosphorylation is the process in which ADP (Adenosine Diphosphate) is converted into ATP (Adenosine Triphosphate) by the addition of one phosphate (Pi) group, i.e inorganic phosphate, utilizing the energy from photons.

Q. 3. Destarching
(A) The process in which plant is kept in the dark to remove the starch from the leaves.
(B) The process in which plant is kept in the dark to remove the starch from the roots.
(C) The process in which plant is kept in the light to remove the starch from the leaves.
(D) The process in which plant is kept in the dark to accumulate the starch from the leaves.

Ans. Option (A) is correct.

Explanation: Destarched plant is the one which is kept in the dark to remove the starch from the leaves. The process for destarching is done by keeping the plant in dark for 2-3 days.

Q. 4. Autotrophs
(A) Organism manufacturing their own food.
(B) Organism who can't manufacturing their own food.
(C) Organism manufacturing food automatically.
(D) Organism manufacturing their own soil.

Ans. Option (A) is correct.

Explanation: Autotrophs are the organisms capable of synthesizing their required nutrients from simple inorganic compounds in the presence of solar energy and chlorophyll.

State the function of the following:

Q. 1. Chloroplast
(A) To perform respiration
(B) To perform photosynthesis
(C) To synthesis protein
(D) To synthesis DNA

Ans. Option (B) is correct.

Explanation: The main function of chloroplast is to trap the light energy and to transform this energy into chemical energy, i.e. ATP and NADPH to be used in dark reactions, thus performing photosynthesis.

AI Q. 2. Guard cells
(A) Regulate O_2 influx from the atmosphere into the leaves for photosynthetic carbon fixation.
(B) Regulate CO_2 influx from the atmosphere into the leaves for photosynthetic carbon fixation.
(C) Regulate O_2 influx from the atmosphere into the leaves for photosynthetic oxygen fixation.
(D) Regulate CO_2 influx from the atmosphere into the leaves for photosynthetic carbon fixation.

Ans. Option (D) is correct.

Explanation: Guard cells regulate CO_2 influx from the atmosphere into the leaves for photosynthetic carbon fixation. Stomatal guard cells also regulate water loss of plants via transpiration to the atmosphere.

Q. 3. Phloem
(A) Transports starch from the roots to all parts of the plant body.
(B) Transports starch from the flowers to all parts of the plant body.
(C) Transports proteins from the leaves to all parts of the plant body.
(D) Transports starch from the leaves to all parts of the plant body.

Ans. Option (D) is correct.

Explanation: Phloem transports organic food i.e. starch made in leaves to all storage organs of the plant body.

AI Q. 4. Stroma
(A) Performs dark reactions of photosynthesis.
(B) Performs light reactions of photosynthesis.
(C) Performs light and dark reactions of photosynthesis.
(D) Performs dark reactions of respiration.

Ans. Option (A) is correct.

Explanation: The dark phase occurs in the stroma of the chloroplast where all the enzyme necessary for CO_2 fixation and synthesis of sugar and starch are located.

State the exact location of the following :

Q. 1. Thylakoids
(A) In chromoplast (B) In chloroplast
(C) In mitochondria (D) In cytoplasm
Ans. Option (B) is correct.

Explanation: It is present in stroma/matrix of chloroplast.

Q. 2. Chloroplast
(A) In mesophyll cells (B) In root cells
(C) In phloem tissues (D) In anther
Ans. Option (A) is correct.

Explanation: Chloroplast mainly found in the mesophyll cells are located between upper and lower epidermis of the leaves.

Q. 3. Grana
(A) Inside thylakoid (B) Inside cytoplasm
(C) In stroma (D) In nucleoplasm.
Ans. Option (C) is correct.

Explanation: At some places the thylakoids are arranged themselves to form a stalk of coins like structure called grana in stroma.

Q. 4. Stroma
(A) In chloroplast (B) In mitochondria
(C) In cytoplasm (D) In thylakoid
Ans. Option (A) is correct.

Explanation: Internally chloroplast contains a matrix or stroma.

Q. 5. When a plant is kept in a dark room for about 48 hrs before conducting any experiment on photosynthesis to:
(A) Remove chlorophyll form leaves
(B) Remove starch from the plant
(C) Ensure that no photosynthesis occurs
(D) Ensure that the leaves are free from starch
Ans. Option (D) is correct.

Explanation: In dark plant cannot perform photosynthesis. Thus, there is no starch formation occurs. Also within 48 hours previously stored starch is being used up. So, all leaves will be starch free prior to any experiment.

AI Q. 6. In the destarched plant, the leaves become decolorise as the
(A) Leaves are free from chlorophyll
(B) Aerial parts are free from starch
(C) Leaves are free from starch
(D) Plant is free from starch.
Ans. Option (C) is correct.

Explanation: Destarched plant is the one which is kept in the dark to remove the starch from the leaves. The process for destarching is done by keeping the plant in dark for 2-3 days.

Q. 7. Each flattened stacks of membranous coined like structures inside the chloroplast are known as :
(A) Grana (B) Stroma
(C) Thylakoids (D) Cristae
Ans. Option (A) is correct.

Explanation: At some places the thylakoids are arranged themselves to form a flattened stack of coins like structure called grana.

Q. 8. The process of conversion of several molecules of glucose to one molecule of starch is called:
(A) Polypeptidation (B) Polymerization
(C) Polyacylation (D) Polysynthesis
Ans. Option (B) is correct.

Explanation: The monosaccharide glucose can bond in a condensation polymerisation reaction to produce starch or glycogen. Glucose molecules react together in a condensation polymerisation reaction.

AI Q. 9. Which type of tissue transports starch from the leaves to all parts of the plant body?
(A) Xylem (B) Phloem
(C) Parenchyma (D) Collenchyma
Ans. Option (B) is correct.

Explanation: Phloem tissues in plants that conduct foods made in the leaves to all other parts of the plant. Phloem is composed of various specialized cells that are sieve tubes, companion cells, phloem fibres, and phloem parenchyma cells.

Q. 10. What is the process of conversion of ADP into ATP during photosynthesis called?
(A) Photophosphorylation
(B) Dephosphorylation
(C) Oxidative Phosphorylation
(D) Diphosphorylation
Ans. Option (A) is correct.

Explanation: Photophosphorylation is the process in which ADP (Adenosine Diphosphate) is converted into ATP (Adenosine Triphosphate) by the addition of one phosphate (Pi) group, i.e. inorganic phosphate, utilizing the energy from photons.

Q. 11. Name the ground substance present in a chloroplast.
(A) Cytoplasm (B) Cell sap
(C) Stroma (D) Grana
Ans. Option (C) is correct.

Explanation: Stroma is the colourless fluid fill present in the inner space of the chloroplasts which encloses the grana and the thylakoids.

Q. 12. An aquatic plant used in the lab to demonstrate oxygen liberation during photosynthesis.
(A) Lotus (B) Water hyacinth
(C) *Nymphaea* (D) *Hydrilla*
Ans. Option (D) is correct.

Explanation: A water plant such as *Hydrilla* does the process of photosynthesis just as plants that grow in the air do, but the bubbles which can be observed that indicate photosynthesis is occurring they form on the leaves before they float to the surface, enabling an easy measurement of photosynthesis.

Q. 13. What is photolysis?
(A) Splitting of water molecules
(B) Splitting of glucose molecules
(C) Splitting of starch molecules

(D) Formation of starch

Ans. **Option (A) is correct.**

Explanation: Photolysis is a process of splitting of water molecule into $2H^+ + 4e^- + \frac{1}{2} O_2$ in the presence of sunlight by activated photosynthetic pigments.

Q. 14. Where the dark reaction of photosynthesis does takes place?
(A) Grana (B) Cytoplasm
(C) Stroma (D) Thylakoid

Ans. **Option (C) is correct.**

Explanation: The dark reaction of photosynthesis occurs in the stroma of the chloroplast where all the enzyme necessary for CO_2 fixation and synthesis of sugar and starch are located.

Q. 15. Factor affecting rate of photosynthesis
(A) Light
(B) Carbon dioxide concentration
(C) Water
(D) All of the above

Ans. **Option (D) is correct.**

Explanation: There are certain factors which directly or in directly affect the rate of photosynthesis. These include light, CO_2 concentration, temperature, water etc.

Q. 16. Chlorophyll is present in which part of plant cell?
(A) Cytoplasm (B) Ribosome
(C) Chloroplast (D) Mitochondria

Ans. **Option (C) is correct.**

Explanation: Chlorophyll is the main photopigment found in green plants in cell organelle chloroplast.

Q. 17. What is the exact location of chlorophyll pigment in the chloroplast?
(A) Double membrane of chloroplast
(B) Grana (C) Thylakoid
(D) Stroma

Ans. **Option (C) is correct.**

Explanation: The green pigment chlorophyll is located within the thylakoid membrane. It is embedded in the membrane structure.

Q. 18. What does the blue colour indicates in iodine test?
(A) Presence of glucose (B) Presence of starch
(C) Absence of glucose (D) Absence of starch

Ans. **Option (B) is correct.**

Explanation: Iodine is an indicator that turns blue-black in the presence of starch.

Q. 19. Leaf is boiled in alcohol for iodine starch test to ensure:
(A) Removal of starch
(B) Removal of glucose
(C) Removal of protein
(D) Removal of chlorophyll

Ans. **Option (D) is correct.**

Explanation: Boiling of the leaf in alcohol is done when we are checking it for starch to eradicate chlorophyll, which is the green pigment present in leaves.

AI Q. 20. Choose the correct answer from the four options given below in the statement.
A plant is kept in a dark cupboard for about 48 hrs before conducting any experiment on photosynthesis to
(A) Remove chlorophyll form leaves
(B) Remove starch from the plant
(C) Ensure that no photosynthesis occurs
(D) Ensure that the leaves are free from starch

Ans. **Option (B) is correct.**

Explanation: Remove starch from the plant.

ASSERTION AND REASON MCQs

Directions: In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:
(A) Both (A) and (R) are true, and (R) is the correct explanation of (A).
(B) Both (A) and (R) are true, but (R) is not the correct explanation of (A).
(C) (A) is true, but (R) is false.
(D) (A) is false, but (R) is true.

Q. 1. **Assertion (A):** All life on Earth is supported by photosynthesis.
Reason (R): Photosynthesis is the process in which green plants prepare their food. R

Ans. **Option (B) is correct.**

Explanation: All organisms depend directly or indirectly on green plants for food, beginning of all food chains, provides oxygen for respiration.

Q. 2. **Assertion (A):** Sleeping under a tree at night not advisable.
Reason (R): Plant produce carbon monoxide at night.

Ans. **Option (A) is correct.**

Explanation: Sleeping under a tree at night is not advisable because plants respire at night due to which the atmosphere surrounding the tree is rich in carbon dioxide which is harmful for us.

Q. 3. **Assertion (A):** Animals owe their existence to chlorophyll.
Reason (R): Plants with chlorophyll produce the food used by all the living organisms.

Ans. **Option (A) is correct.**

Explanation: Plants produce their own food by using light and chlorophyll. The herbivores directly eat plants. Thus, all types of animals, including man, depend on plants directly or indirectly for food.

Q. 4. **Assertion (A):** Plants manufacture their own food.
Reason (R): Plants are autotrophs.

Ans. **Option (A) is correct.**

Explanation: Organisms capable of synthesizing their required nutrients from simple inorganic compounds in the presence of solar energy and chlorophyll.

Q. 5. **Assertion (A):** Certain green leaves are thin and broad.
Reason (R): There are different shapes and size of leaves.

Ans. Option (B) is correct.

Explanation: Certain green leaves are thin and broad so as to provide the large surface area for trapping light and easy gaseous exchange for photosynthesis to occur.

Q. 6. **Assertion (A):** The dark reaction of photosynthesis is light independent.
Reason (R): It utilizes the products of light reactions.

Ans. Option (B) is correct.

Explanation: Dark reaction of photosynthesis is also called Calvin cycle or light independent reaction. It utilizes the products of light reactions but does not utilise light in the reaction.

Q. 7. **Assertion (A):** Photophosphorylation requires oxygen molecule.
Reason (R): Formation of ATP takes place in photophosphorylation.

Ans. Option (D) is correct.

Explanation: Photophosphorylation is the process in which ADP (Adenosine Diphosphate) is converted into ATP (Adenosine Triphosphate) by the addition of one phosphate (Pi) group, i.e., inorganic phosphate, utilizing the energy from photons.

Q. 8. **Assertion (A):** Dark reaction (Biosynthetic phase) or Blackman's reaction involves the fixation and reduction of CO_2.
Reason (R): Dark reaction does not take place in light.

Ans. Option (C) is correct.

Explanation: Dark reactions are light independent but it can occur in presence or absence of light.

Q. 9. Assertion (A): Raw materials needed for photosynthesis are carbon dioxide, water and light energy.
Reason (R): Photosynthesis is the only process by which solar energy is converted into chemical energy.

Ans. Option (B) is correct.

Explanation: Photosynthesis is the process in which green plants or their parts produce complex carbon containing compounds with the help of inorganic raw materials such as CO_2 and water in the presence of sunlight. O_2 is liberated as the by-product.

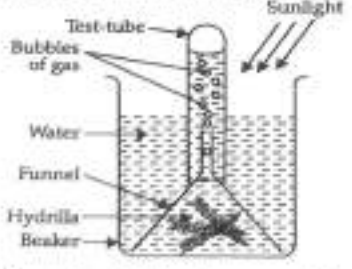
Q. 10. **Assertion (A):** Chloroplast helps to perform photosynthesis.
Reason (R): Chloroplast has all the necessary enzyme for photosynthesis.

Ans. Option (A) is correct.

Explanation: A chloroplast is an oval, minute, double membrane organelle present in green plants. It contains all enzymes and a green pigment called chlorophyll which absorbs light energy for photosynthesis.

CASE-BASED MCQs

AI I. The figure given represents an experiment setup to study a physiological process in plants.. Study the same and answer the questions from Q1 to Q5.



Q. 1. Name the physiological process being studied.
(A) Respiration (B) Photosynthesis
(C) Transpiration (D) Guttation

Ans. Option (B) is correct.

Explanation: Photosynthesis is the process in which green plants or their parts produce complex carbon containing compounds with the help of inorganic raw materials such as CO_2 and water in the presence of sunlight. O_2 is liberated as the by-product.

Q. 2. What is the aim of the experiment?
(A) To prove that carbon di oxide is released during respiration.
(B) To prove that carbon di oxide is released during photosynthesis.
(C) To prove that oxygen is released during photosynthesis.
(D) To prove that oxygen is released during respiration.

Ans. Option (C) is correct.

Explanation: Photosynthesis is the process in which green plants or their parts produce complex carbon containing compounds with the help of inorganic raw materials such as CO_2 and water in the presence of sunlight. O_2 is liberated as the by-product. The whole of the oxygen liberated comes from water, by a process called photolysis of water.

Q. 3. Give one precaution of the experiment.
(A) Twigs of *Hydrilla* plant are fixed properly inside the funnel.

(B) Twigs of *Hydrilla* plant are freely placed inside the funnel.
(C) Twigs of any plant are fixed properly inside the funnel.
(D) Twigs of *Hydrilla* plant are fixed properly above funnel.

Ans. Option (A) is correct.

Explanation: The *Hydrilla* plant should be kept in the beaker and covered with the funnel. *Hydrilla* plant is placed in such a way that it's cutting ends remain towards the stem of the funnel.

Q. 4. Which gas is shown in the figure?
(A) Oxygen (B) Carbon dioxide
(C) Hydrogen (D) Nitrogen

Ans. Option (A) is correct.

Explanation: The liberated gas is oxygen and it is evolved due to the photolysis of water under the procedure of photosynthesis. The liberated gas comes in the intercellular spaces and eventually evolves out during the stomata.

Q. 5. *Hydrilla* is :
(A) Aerial plant (B) Amphibian
(C) Underground plant (D) Aquatic plant

Ans. Option (D) is correct.

Explanation: *Hydrilla* plants are water plants. These plants can bring out photosynthesis even they are surrounded by water.

II. The given diagram is a diagrammatic representation of the internal structure of an organelle found in a plant cell. Study the same and then answer any four questions from Q1. to Q5.

Q. 1. Identify the organelle.
(A) Chloroplast (B) Mitochondria
(C) Ribosome (D) Golgi body

Ans. Option (A) is correct.

Explanation: A chloroplast is an oval, minute, double membrane organelle present in green plants. Internally it contains a matrix or stroma and the thylakoids. At some places the thylakoids are arranged themselves to form a stack of coins like structure called grana.

Q. 2. Name the physiological process occurring in this organelle.
(A) Respiration (B) Photosynthesis
(C) Protein Synthesis (D) DNA synthesis

Ans. Option (B) is correct.

Explanation: Photosynthesis in the process which occurs in the chloroplast. It is the process in which green plants or their parts produce complex carbon containing compounds with the help of inorganic raw materials such as CO_2 and water in the presence of sunlight. O_2 is liberated as the by-product.

Q. 3. How the process occurs in above organelle is beneficial to human beings?
(A) It provides food for human beings.
(B) It provides oxygen to human beings.
(C) Both of the above
(D) None of the above

Ans. Option (C) is correct.

Explanation: Photosynthesis is important to living organisms because it is the number one source of oxygen in the atmosphere. Photosynthesis produces glucose which ultimately provides food to humans.

Q. 4. Name the types of reactions in the process occurring in the part labelled "A" and "B".
(A) Part A– Dark reaction, Part B– Light reaction
(B) Part A– Light reaction, Part B– Light reaction
(C) Part A– Dark reaction, Part B– Dark reaction
(D) Part A– Light reaction, Part B– Dark reaction

Ans. Option (A) is correct.

Explanation: Light reaction takes place in thylakoids and dark reaction takes place in stroma of chloroplast.

Q. 5. State the exact location of this organelle.
(A) Cortex (B) Phloem
(C) Mesophyll (D) Epidermis

Ans. Option (C) is correct.

Explanation: Chloroplast mainly found in the mesophyll cells is located between upper and lower epidermis of the leaves.

AI III. Read the paragraph carefully. Answer any four questions from Q1. to Q5.

A potted plant was taken in order to prove a factor necessary for photosynthesis. The potted plant was kept in the dark for 24 hrs. One of the leaf was covered with black paper in the centre. The potted plant was then placed in sunlight for a few hours. The leaf is then tested for the presence of starch.

Q. 1. What aspect of photosynthesis was being tested?
(A) Sunlight is necessary for photosynthesis.

(C) Oxygen is necessary for photosynthesis.
(D) Heat is necessary for photosynthesis.

Ans. Option (A) is correct.

Explanation: Photosynthesis is successfully accomplished in the visible light (380 – 760 nm wave-length) of the spectrum. Sunlight provides light energy to the plant for the process.

Q. 2. Why was the plant placed in the dark before beginning the experiment?
(A) To remove chlorophyll from leaf
(B) To remove fat from leaf
(C) To remove protein from leaf
(D) To remove starch from leaf

Ans. Option (D) is correct.

Explanation: Plant is placed in the dark before beginning the experiment to make the leaves free from starch that is to destarch.

Q. 3. Leaf is boiled in alcohol for iodine starch test for:
(A) Removal of starch
(B) Removal of glucose
(C) Removal of protein
(D) Removal of chlorophyll

Ans. Option (D) is correct.

Explanation: Boiling of the leaf in alcohol is done when we are checking it for starch to eradicate chlorophyll, which is the green pigment present in leaves.

Q. 4. Which part of leaf will show positive starch test?
(A) Green part of leaf (B) Yellow part of leaf
(C) Both parts (D) None of these

Ans. Option (B) is correct.

Explanation: Green part does not received light as it was covered. Thus, no starch will be produced by photosynthesis in that part.

Q. 5. Which solution is used for starch test?
(A) Iodine (B) Chlorine
(C) Methylene blue (D) Hydrochloric acid.

Ans. Option (A) is correct.

Explanation: Iodine is an indicator that turns blue-black in the presence of starch.

AI IV. The diagram given below represents an experiment to prove the importance of a factor in photosynthesis Study the same and then answer any four questions from Q1 to Q5.

Q. 1. Which factor is being studied here?
(A) Sunlight is necessary for photosynthesis
(B) Carbon dioxide is necessary for photosynthesis
(C) Oxygen is necessary for photosynthesis
(D) Water is necessary for photosynthesis

Ans. Option (B) is correct.

Explanation: CO_2 is necessary for photosynthesis is shown by Moll's half leaf experiment. It is prime ingredient for the formation of glucose.

Q. 2. What is the purpose of keeping KOH in the flask?
(A) KOH removes CO_2 gas.
(B) KOH removes O_2 gas.
(C) KOH removes water vapour.
(D) KOH removes hydrogen molecule.

Ans. Option (A) is correct.

Explanation: KOH (Potassium Hydroxide) absorbs carbon dioxide. This will help to check the factor Carbon Dioxide is necessary for the photosynthesis.

Q. 3. What will you observe when the leaf kept inside the bottle is tested for starch?
(A) No starch present
(B) Complete leaf shows the presence of starch.
(C) Half of the leaf turns blue black giving positive starch test while half of the leaf will give negative test of starch.
(D) Central part of leaf will show positive starch test.

Ans. Option (C) is correct.

Explanation: The part of leaf inside the bottle containing KOH solution does not become blue black when compared with the part of leaf which is exposed to atmospheric air. This shows that carbon dioxide is necessary for photosynthesis.

Q. 4. Carbon dioxide fixation takes place in place in photosynthesis during
(A) Dark reactions
(B) Light reaction
(C) Both reactions
(D) No fixation of carbon dioxide

Ans. Option (A) is correct.

Explanation: Dark reaction (Biosynthetic phase) or Blackman's reaction involves the fixation and reduction of CO_2 resulting in the formation of carbohydrates.

Q. 5. Enzymes necessary for carbon dioxide fixation are present in:
(A) Grana of chloroplast (B) Stroma of chloroplast
(C) Vacuole cell sap (D) Inside nucleus

Ans. Option (B) is correct.

Explanation: The dark phase occurs in the stroma of the chloroplast where all the enzyme necessary for CO_2 fixation and synthesis of sugar and starch are located.