11.TRANSPORT IN PLANTS

Biology Smart Booklet

Theory + NCERT MCQs + NEET PYQs

TRANSPORT IN PLANTS

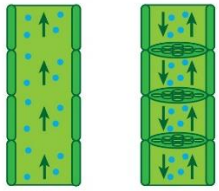
Transport of substances over long distances in plants through vascular system (xylem-phloem)

VASCULAR TISSUES XYLEM & PHLOEM

- Xylem - movement is from roots to aerial parts of plants.
- Phloem - movement is from leaves to other parts of plants
- Xylem - movement is unidirectional
- Phloem - movement is bidirectional
- Xylem - translocation of water
- mineral salts, nitrogen & hormones
- Phloem - translocation of organic & inorganic solutes

IMPORTANT TERMS

- Mycorrhiza → Symbiotic association of fungus with root system.
- Guttation → Exudation of water from the pores of leaves. It is the excess water that collects as drops.



XYLEM AND PHLOEM

GIRDLING EXPERIMENT

- Done to identify tissue transporting flood
- Done by removing bark of stem

TRANSLOCATION

- Passive movement of molecules from high concentration to low concentration

DIFFUSION

MEANS OF TRANSPORT

FACILITATED DIFFUSION

- UNIPORT
  - Only one molecule move across the membrane independent of other.
- SYMPORT
  - Two molecules move across the membrane in same direction
- ANTIPORT
  - Two molecules move across the membrane in opposite direction
- Imager uniport, symport & antiport

ACTIVE TRANSPORT

- Energy mediated transport to pump molecules against concentration gradient

PHLOEM TRANSPORT

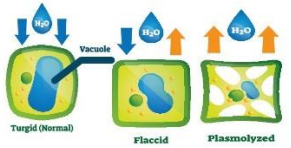
- Long distance movement of organic substance from source to sink.

SHORT DISTANCE TRANSPORT

(By simple diffusion)

PLANT - WATER RELATIONS

- Water potential - $\Psi w = \Psi S + \Psi P$
- Osmosis - movement of solvent molecules from their region of high concentration to low concentration across the selectively permeable membrane
- Plasmolysis - Shrinkage of cell is protoplasm away from the cell wall in centre.
- Imbibition - Special type of diffusion in which water is absorbed by solids to increase in volume.



PRESSURE FLOW OR MASS FLOW HYPOTHESIS

- Explains two mechanism of translocation of sugar (Phloem sap).
- Phloem sap is water & sucrose
- Sap travels from source (region of synthesis of food leaf) to sink (region of storage or utilization of food
- Difference in osmotic pressure is the basis of movement of sap

UPTAKE & TRANSPORT OF MINERAL NUTRIENTS

UPTAKE OF MINERAL

- Minerals enter the roots by active absorption
- It requires ATP

TRANSLOCATION OF MINERALS

- Ions reach xylem through active or passive uptake
- From xylem, transpiration stream translocates minerals
- Unloading of mineral ions occurs through diffusion

TRANSPIRATION

- Loss of water & exchange of gasel (O_2 & Co_2) through stomata.
- Stomata opening & closing regulated by turgidity of guard cells.

LONG DISTANCE TRANSPORT OF WATER

WATER MOVEMENT UP THE PLANT

TRANSPIRATION PULL

- Transpiration is movement of water molecules upto the leaves & it's loss through stomata evaporative
- Transpiration creates a driving force for water (pull pressure) that is described by cohesion tension transpiration pull model.

ROOT PRESSURE

- It is the positive pressure developed in roots due to active absorption of ions & water
- Responsible for pulling water upto a small height

ABSORPTION OF WATER

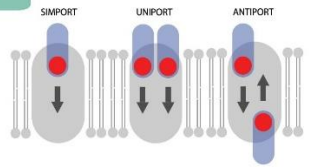
APOPLAST PATHWAY

- Mostly used pathway
- Occurs through intercellular or spaces
- Dependents or gradient
- Mass flow of water occurs due to cohesive & adhesive properties of water.

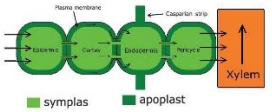
SYMPLAST PATHWAY

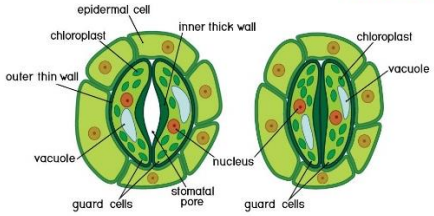
- System of interconnected protoplasts.
- Movement is aided by cytoplasmic streaming as cells are connected through plasmodesmata
- Water movement is slow in this pathway.

- APOPLAST PATHWAY IS DISCONTINUOUS AT CASPARIAN STRIPS OF THE ENDODERMIS IN THE ROOTS



Pathway of water movement in root





Stomata open Stomata closed

TRANSPORT IN PLANTS

Translocation

Long distance transport occurs through vascular system, xylem and phloem called translocation through mass flow. The direction of translocation may be unidirectional as in case of water and multidirectional as in minerals and organic solutes.

Means of transport (Short distance transport)

The transport of material into and out of the cells is carried out by number of methods. These are diffusion, facilitated diffusion and active transport.

Diffusion

In this system, the molecules move from a region of higher concentration to a region of lower concentration. This process requires no energy.

Factors affecting diffusion: Permeability of membrane, Temperature, pressure, gradient of concentration and the size of substances.

Facilitated diffusion: The diffusion of hydrophilic substances along the concentration gradient through fixed membrane transport protein without involving energy expenditure. For this the membrane possess aquaporins and ion channels. No ATP energy is utilized in this process.

Methods of Facilitated Diffusion:

- **Symport:** Two molecules cross the membrane in the same direction at the same time.
- **Antiport:** Two molecules move in opposite direction at the same time.
- **Uniport:** Single molecules moves across membrane independent of other molecules.

Porins: The proteins that form huge pores in the outer membranes of the plastids, mitochondria and some bacteria which allow the small size molecules to pass through.

Aquaporins: Proteins that facilitate diffusion of water molecules through/ across the plasma membrane of cell.

Facilitated Transport

Here, the system moves molecules from a region of higher concentration to a region of lower concentration with the help of a carrier, usually a protein. This process does not require any energy and hence is known as the passive process.

Active Transport

This mechanism transfers molecules from a region of lower to a region of higher

concentration with the help of membrane proteins. This system is termed as active transport because it requires ATP to function.

Water Potential

Water potential is used by the plants to transport water to the leaves that help in carrying out photosynthesis. Solute potential and pressure potential are the two main components of water potential.

Solute potential is also known as osmotic potential and is negative in the plant cell. Pressure potential is positive in the plant cell. Higher the concentration of water in the system, greater will be the water potential.

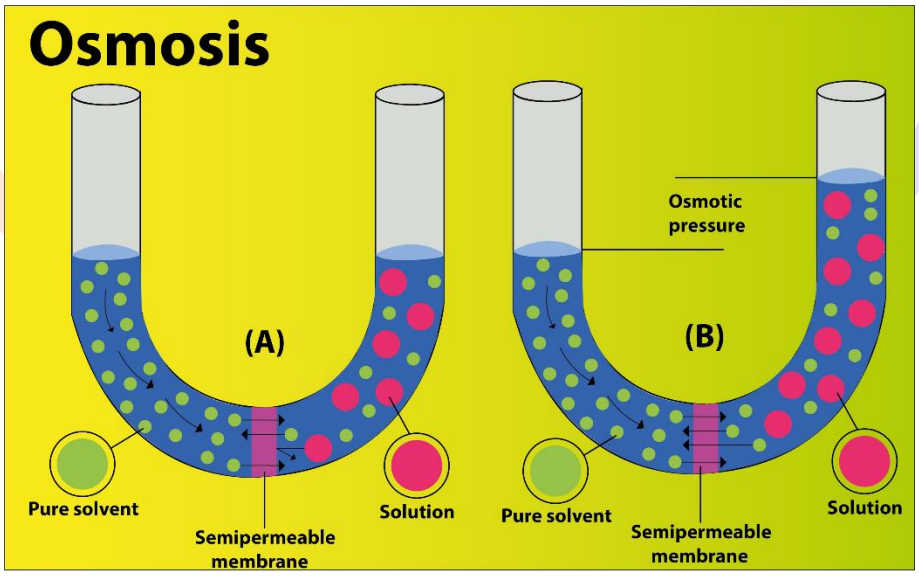
Osmosis

Osmosis is the movement of molecules from a region of higher concentration to a region of lower concentration across a semi-permeable membrane until an equilibrium is reached.

The plant cell wall is freely permeable to substances in solution and water.

Osmosis is of two types:

- **Endosmosis:** This is the movement of water molecules enters into the cell when the cell is placed in a hypotonic solution.
- **Exosmosis:** This is the movement of water molecules out of the cell when the cell is placed in a hypertonic solution.



Isotonic: If the surrounding solution balances the osmotic pressure of cytoplasm, the solution is called isotonic.

Hypotonic: If the external solution is more dilute than cytoplasm, it is hypotonic. The cells swell up when placed in hypotonic solution.

Hypertonic: If the external solution is more concentrated than cytoplasm, it is hypertonic. Cell will shrink in hypertonic solution.

Plasmolysis

Plasmolysis is the shrinkage of the cytoplasm of the cell away from its cell wall under the influence of hypertonic solution. The pressure of plasmolysis is usually reversible when the cell is placed in hypotonic solution.

Turgor pressure

The pressure builds up against the wall due to movement of water inside is called turgor pressure. It is responsible for enlargement and extension growth of cells.

Imbibition

Imbibition is a special type of diffusion when water is absorbed by solid colloids causing them to increase in volume. For example, absorption of water by seeds and dry woods. Imbibition is also a kind of diffusion because movement of water is from higher concentration to lower concentration.

Mass or bulk flow system

Long distance transport of water in plants takes place by mass or bulk flow system. It is the movement of substance in bulk from one point to another as a result of pressure difference between two points.

Absorption of water by plants

Water is absorbed along with mineral solutes by root hairs by diffusion. The absorbed water passes to deeper layer by two pathways.

Apoplast pathway

- It consists of non-living parts of plants body such as cell wall and intercellular spaces.
- There is little resistance in movement of water.
- It is faster.
- Metabolic state of root does not affect apoplast pathway.

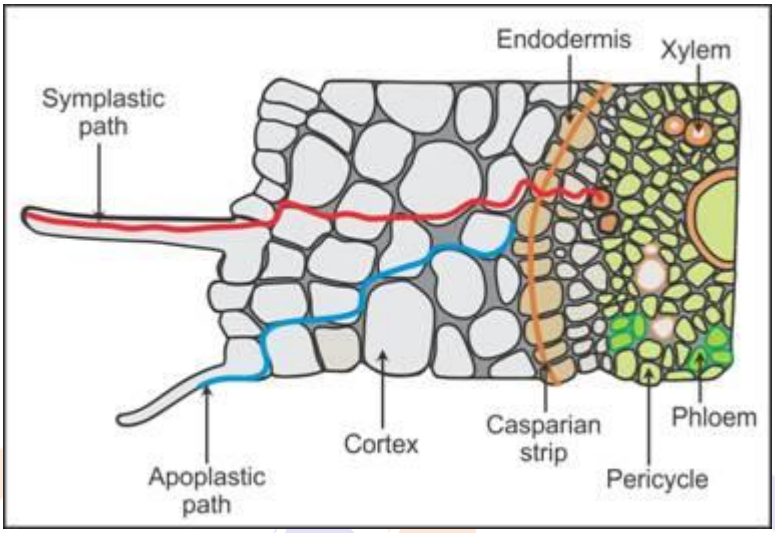
Symplast pathway

- It consists of living parts of plant body such as protoplast connected to plasmodesmata.
- Some resistance occurs in the movement of water.
- It is slightly slower.
- Metabolic state of root directly affect symplast pathway.

Casperian strip

The inner boundary of cortex, endodermis is impervious to water due to suberised matrix called Casperian strip. Water molecules are directed through wall regions that are not suberised.

Water flows through the different layers of roots to reach the xylem tissues as follows:



Mycorrhiza

A mycorrhiza is the symbiotic association between a fungus and angiospermic roots. The fungal filaments form a network around the young root to have large surface area that help to absorb mineral ions and water from the soil. The fungus provides minerals and waters and roots in turn provide organic and nitrogen containing compounds.

Vital force theory

Vital force theory was forwarded by J.C. Bose in 1923. This theory believes that the innermost cortical cells of the root absorb water from the outer side and pump the same into xylem channels.

Pressure theory

Root pressure theory was forwarded by Priestley in 1916. Root pressure is positive pressure that develops in the xylem sap of the root of plants. It can be responsible for pushing up water to small heights in plants.

Guttation

Loss of water in liquid phase by herbaceous plants from the tips of leaf blades is known as guttation.

Theory of Capillarity

Water rises in tubes of small diameters, kept in vessels having water due to force of surface tension. Similarly, water rises in the walls of xylem channels due to adhesion and cohesion. This theory is called Theory of Capillarity.

Tension theory

Cohesion Tension theory was put forwarded by Dixon and Joly in 1894. According to this theory water is mostly pulled due to driving force of transpiration from the leaves. The water molecules remain attached with one another by cohesion force. The water molecule does not break in vessels and tracheid due to adhesive force between their walls and water molecules. Because of tension

created by transpiration, the water column of plant is pulled up passively from roots to great heights.

Transpiration is the loss of water in the form of water vapour from aerial parts of plants. The following purpose is fulfilled by transpiration.

- Creates transpirational pull for absorption and transport in plants.
- Supplies water for photosynthesis.
- Transport minerals and salts from soil to other parts of plant.
- Cool the leaves and maintain their shape and size.

Photosynthesis is limited by available water. C_4 plants are twice as efficient as C_3 plants in term of fixing carbon. Although C_4 plants uses half as much water as C_3 plants for the same amount of CO_2 fixed.

Uptake and transport of mineral nutrients

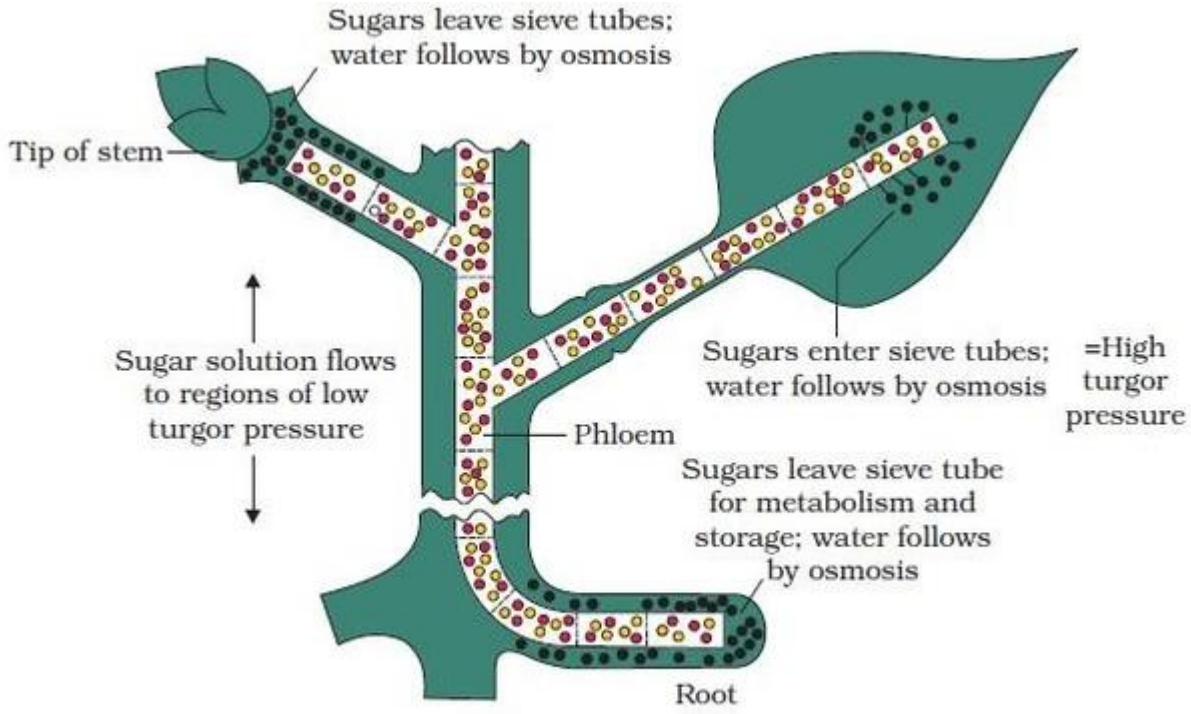
- Most of the minerals enter the roots by active absorption into the cytoplasm of epidermal cells because.
- Minerals are present in the soil as charged particles (ions) which cannot move across cell membranes.
- The concentration of ions in soil is usually lower than concentration in roots.
- Active absorption needs energy in form of ATP. Active uptake of ions is also responsible for water potential gradient in roots.
- Transport proteins of epidermal cells are control point where quantity and type of solutes that reach the xylem is adjusted.
- The ions that reaches to xylem by active or passive transport moves further upward along with transpirational pull.
- The chief sink of mineral elements are growing region of plants like apical meristem, young leaves, growing flower and fruit, and the storage organs.
- Minerals are frequently remobilized from older senescing part of the plants to young growing parts of plant.
- The elements most readily mobilized include phosphorus, Sulphur, nitrogen and potassium. The element like calcium is not mobilized as it is the structural components of plant body.

Phloem transport

Flow from Source to Sink

- Food (sucrose) is transported by phloem from source to sink. The part of plant that synthesize the food is called source and part where food is used or stored is called sink.
- The source and sink can be reversed by the plants depending upon the season or plant's need. So, the direction of movement in the phloem is bi-directional.

- Phloem sap is mainly water and sucrose, but other sugars, hormones and amino acids are also translocated through it.



Diagrammatic presentation of mechanism of translocation

Pressure flow or Mass flow hypothesis

- It is the most accepted theory for the translocation of sugar from source to sink. Glucose is prepared at source by photosynthesis which is converted into disaccharides (sucrose). Sucrose moves into companion cells and then into sieve tube cells by active transport.
- Loading of phloem at source creates a water potential gradient that facilitates the mass movement in the phloem.
- Sieve tube cells of phloem forms a long column with holes in their wall called sieve plates. Cytoplasmic strands pass through the hole in the sieve plates to form continuous filament. Hydrostatic pressure developed in sieve tube cells moves the sap in the phloem.
- At sink, incoming sugar is actively moved out of the phloem as complex carbohydrates. The loss of solute produces a high-water potential in the phloem and water passes out and returning into xylem.

NCERT LINE BY LINE QUESTIONS

1. Melvin Calvin earned Nobel prize in 1961 for
(A) mapping pathway of carbon assimilation in respiration
(B) mapping pathway of carbon absorption in photosynthesis
(C) mapping pathway of carbon assimilation in photosynthesis
(D) mapping pathway of carbon absorption in respiration. **Page – 174, Easy**

2. Cytoplasmic streaming helps to move substances over
(A) long distances (B) small distances
(C) Both (a) and (b) (D) None **Page – 175, Easy**

3. Translocation is transport over
(A) long distance (B) short distance
(C) Both long and short distance (D) None of these **Page – 175, Easy**

4. Transport of minerals in plants is
(A) unidirectional only (B) multidirectional
(C) Both unidirectional & multidirectional
(D) Dependent on the hormones released **Page – 175, Easy**

5. Nutrients are re-exported from
(A) nascent leaves to senescent leaves
(B) senescent leaves to nascent leaves
(C) all parts to senescent leaves
(D) not re-exported **Page – 176, Easy**

11.1.1 Diffusion

6. Movement by diffusion is
(A) active with energy expenditure (B) passive with energy expenditure
(C) both active and passive (D) without energy expenditure
Page – 176, Easy

7. In diffusion, molecules
(A) move in a fixed fashion, from high to low concentration
(B) move in random fashion, from high to low concentration
(C) move in fixed fashion, from low to high concentration
(D) move in random fashion, from low to high concentration. **Page – 176, Easy**

8. Diffusion
(A) in solid is more likely rather than of solid
(B) of solid is more likely than in solid
(C) Both (a) and (b)
(D) Does not occur in solids at all. **Page – 176, Easy**

9. Diffusion rates are affected by
(A) Concentration gradient (B) pressure
(C) temperature (D) All of these **Page – 176, Easy**

10. Statement (A) Diffusion can't occur in dead cell.
Statement (B) Diffusion is the only means for gaseous movement in plant body.
Choose the best option
(A) Statement A is correct and Statement B is wrong
(B) Statement A is wrong and Statement B is correct
(C) Both are correct (D) Both are wrong **Page – 176, Easy**

11.1.2 Facilitated Diffusion

11. Diffusion rate
(A) depend on size and larger substance diffuse faster

(B) depend on size and smaller substance diffuse faster
(C) doesn't depend on size
(D) depend on size and do not substance diffuse larger. **Page – 176, Easy**

12. Hydrophilic moiety substances
(A) diffuse through a membrane easily
(B) do not diffuse through a membrane easily
(C) need no membrane facilitation to diffuse through
(D) Both (a) and (c) **Page – 176, Easy**

13. Read the following statements
(i) Membrane proteins aid in transport of hydrophobic substance.
(ii) Membrane proteins do not set up a concentration gradient.
(iii) Diffusion through membrane proteins is called facilitated diffusion.
(iv) Membrane proteins always need ATP to transport substances across membrane.
How many of the above statements are wrong? **Page – 176, Easy**
(A) 1 (B) 2 (C) 3 (D) 4

14. In facilitated diffusion
(A) special proteins & ATP are involved
(B) only special proteins are involved
(C) only ATP are involved
(D) neither special proteins nor ATP are involved. **Page – 176, Easy**

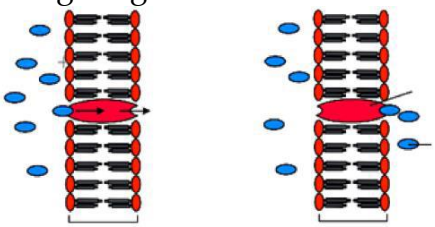
15. Facilitated diffusion cannot
A) transport molecules from high concentration to low concentration
B) transport molecules from low concentration to high concentration
C) Both (a) and (b)
D) Concentration does not matter **Page – 176, Easy**

16. Facilitated diffusion transport is
(i) Saturable (ii) unsaturable
(iii) inhibitable (iv) non-inhibitable
(v) selective (vi) non-selective
(vii) uphill (viii) downhill
Which is the correct combination
(A) i, iii, v, vii (B) ii, iv, vi, viii (C) i, iii, v, viii (D) i, iv, vi, viii
Page – 176-177 Medium

17. Porins are found in
(A) outer membrane of plastids & mitochondria
(B) Inner membrane of plastids & mitochondria
(C) both outer & inner membrane of mitochondria
(D) membrane of lysosoems **Page – 177, Easy**

18. Water channels are made up of ____ different types of aquaporins
(A) 6 (B) 8 (C) 10 (D) 12
Page – 177, Easy

19. Identify the correct label for the figure given



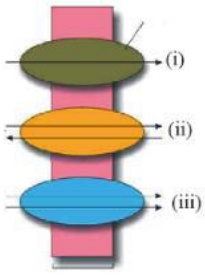
(A) It shows facilitated diffusion
(B) shows simple diffusion
(C) shows sample of water channels

(D) Both (a) and (c) **Page – 177, Easy**

11.1.2.1 Passive symports & antiports

20. (i) Symport will not work if single type of molecule is there.
(ii) Uniport allows two molecules to move in a unidirection together.
(iii) Antiport allows two types of molecules to move in opposite direction.
How many of the above statements is correct
(A) 0 (B) 1 (C) 2 (D) 3
Page – 177, Medium

21. Identify correct statements about the figure given



(A) (i) – It shows simple diffusion via uniport
(B) (ii) – It shows simple diffusion via antiport
(C) Both (a) & (b) are correct (D) None of these **Page – 177, Easy**

11.1.3 Active transport

22. Active transport is
(A) Uphill (B) downhill
(C) unsaturable (D) both (a) and (b) **Page – 178, Easy**

23. Pumps are
(A) energy using transport proteins
(B) non-energy using transport protein
(C) energy using transport lipids
(D) non-energy using transport lipids **Page – 178, Easy**

24. Active transport rate reaches maximum when
(A) All molecules are loaded on carrier proteins
(B) 80% of the molecules are loaded on carrier proteins
(C) 50% of the molecules are loaded on carrier proteins
(D) Can be any of these **Page – 178, Easy**

11.1.4 Comparison of different transport processes

25. Match the columns A & B **Page – 178, Medium**

A	B
(i) Simple diffusion	(I) Uphill
(ii) Facilitated diffusion	(II) Saturable
(iii) Active transport	(III) Selective
	(IV) Passive
	(V) Carrier protein

(A) (i)–III, (ii)–IV, (iii)–I (B) (i)–IV, (ii)–II, (iii)–III
(C) (i)–V, (ii)–IV, (iii)–II (D) (i)–IV, (ii)–I, (iii)–II

11.2 Plant-water relations

26. Most herbaceous plants have about
(A) 10-15% of its dry weight as fresh matter.

(B) 85-90% of its fresh weight as dry matter.
(C) 10-15% of its fresh weight as dry matter.
(D) 85-90% of its fresh weight as water. **Page – 178, Easy**

27. Why is water often limiting factor for plant growth & productivity?
(A) Due to high respiration (B) Due to high photosynthesis
(C) Due to low availability of water (D) Due to transpiration of water
Page – 179, Easy

11.2.1 Water potential

28. Kinetic energy possessed by water molecules is represented directly by its
(A) pressure potential (B) water potential
(C) soluble potential (D) osmotic potential
Page – 179, Easy

29. Pure water has
(A) Lowest water potential at all pressures
(B) Zero water potential at all pressures.
(C) Water potential at all pressures highest
(D) Both (b) and (c) **Page – 179, Easy**

30. Water moves from system containing water at (i) to one with (ii)
(A) (i) – low ψ_w, (ii) – high ψ_w (B) (i) – zero ψ_w, (ii) – zero ψ_w
(C) (i) – positive ψ_w, (ii) – zero ψ_w (D) (i) – high ψ_w, (ii) – low ψ_w
Page – 179, Easy

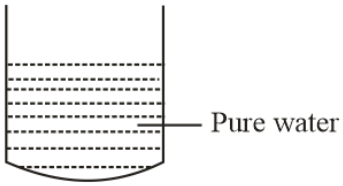
31. Which of the given equations is correct?
(A) $\psi_w = \psi_s + \psi_p$ (B) $\psi_s = \psi_w + \psi_p$
(C) $\psi_p = \psi_s + \psi_w$ (D) $\psi_p = \psi_s - \psi_w$ **Page – 180, Easy**

32. ψ_s is
(A) always positive (B) always negative
(C) sometimes negative (D) mostly zero **Page – 180, Easy**

33. ψ_p is
(A) always positive
(B) always negative
(C) usually positive, sometimes negative
(D) usually negative, sometimes positive **Page – 180, Easy**

34. The more the solute
(A) the lower (less negative) the ψ_p (B) the higher (less negative) the ψ_p
(C) the lower (more negative) the ψ_p (D) the higher (more negative) the ψ_p
Page – 180, Easy

35. If pure water (pH = 7) is kept in open vessel at room temperature, its water potential



(A) zero (B) positive (C) negative (D) can't say
Page – 180, Easy

36. Water potential represents kinetic energy of water molecules.
When $\psi_w = 0$.
(A) kinetic energy of molecules of water is zero.
(B) kinetic energy of molecules of water is not zero.

(C) kinetic energy of molecules of water is negative
(D) kinetic energy of molecules of water is positive **Page – 180, Easy**

11.2.2 Osmosis

37. Cell wall is
(A) impermeable to water and substances in solution
(B) permeable to water and substances in solution
(C) permeable to water but not to substance in solution.
(D) impermeable to water but not to substances in solution. **Page – 180, Easy**

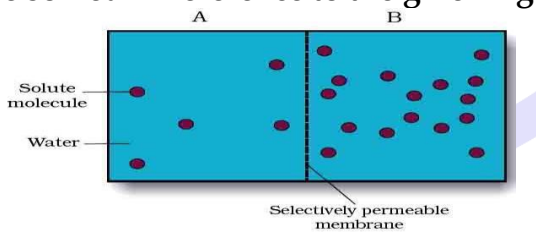
38. Read the following statements
(i) vacuolar sap contribute to solute potential of cell
(ii) cell membrane & tonoplast together are importance determinants of movement of molecules in or out of cells.
(iii) Osmosis occurs spontaneously in response to a driving force
How many of the above statements are Incorrect
(A) 1 (B) 2 (C) 3 (D) None of these
Page – 180, Easy

39. Osmosis refers to
(A) diffusion of solute across permeable membrane
(B) diffusion of solute across differentiallypermeable membrane
(C) diffusion of water across differentially permeable membrane
(D) diffusion of water across permeable membrane **Page – 180, Easy**

40. Water moves under osmosis from
(A) higher chemical potential to lower chemical potential
(B) lower chemical potential to higher chemical potential.
(C) lower potential concentration to higher concentrations.
(D) more than one option is correct. **Page – 180, Easy**

41. In potato osmometer, if potato tuber is placed in water
(A) water exits the cavity of potato tuber via simple diffusion.
(B) water enters the cavity of potato tuber via simple diffusion.
(C) water exits the cavity of potato tuber via osmosis
(D) water enters the cavity of potato tuber via osmosis **Page – 180, Easy**

Questions 42 to 48 are to be solved in reference to the given figure.



42. Which chamber has a lower water potential?
(A) A (B) B
(C) Both are equal (D) Can't say **Page – 180, Medium**

43. Solution of which chamber has more negative solute potential?
(A) A (B) B (C) Both are equal (D) can't say
Page – 180, Medium

44. In which direction will osmosis occur?
(A) from A to B (B) from B to A
(C) No net movement (D) can't say (insufficient data)
Page – 180, Medium

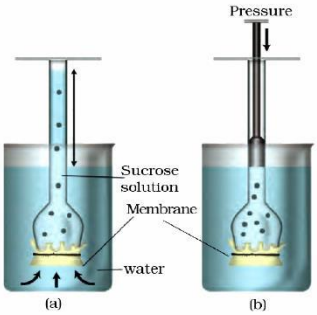
45. Which solution has a higher solute potential?
(A) B (B) A (C) Both are equal (D) can't say
Page – 180, Medium

46. At equilibrium which chamber will have lower water potential?
(A) B (B) A (C) Both are equal (D) Insufficient data
Page – 180, Medium

47. If one chamber has a ψ of –2000 kPa and the other –1200 kPa, which is chamber with higher ψ ?
(A) B (B) A (C) C (D) Can't say
Page – 180, Medium

48. If one of the solutions has $\psi_w = 0.2\,\text{Mpa}$ and other has $\psi_w = 0.1\,\text{Mpa}$ what will be direction of water movement?
(A) A to B (B) B to A
(C) No net movement (D)Random movement
Page – 180, Medium

49. To prevent water from diffusing in pressure is applied. Which of the following statements is correct?



(A) The more the solute, the greater will be pressure required.
(B) The more the solute, the lesser will be pressure required
(C) The pressure is equal to osmotic potential exactly.
(D) Both (a) & (c) **Page – 181, Medium**

50. Osmotic pressure is (ii) & osmotic potential is (ii)
(A) (i) – positive, (ii) negative (B) (i) –negative, (ii) – positive
(C) (i), – positive, (ii) – positive (D) (i) – negative, (ii) – negative
Page – 181, Medium

11.2.3 Plasmolysis

51. Match the columns

A	B
(i) Isotonic	I. external solution is more dilute
(ii) Hypotonic	II. external solution is more concentrated
(iii) Hypertonic	III. external solution balances the osmotic pressure of cytoplasm

(A) (i)-I, (ii)-III, (iii)-II (B) (i)-III, (ii)-I, (iii)-II
(C) (i)-III, (ii)-II, (iii)-I (D) (i)-II, (ii)-I, (iii)-III
Page – 181, Medium

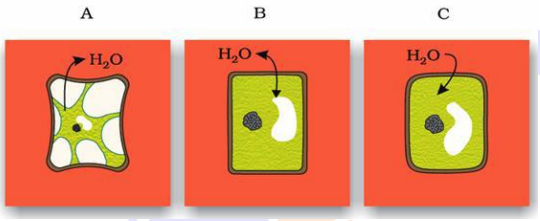
52. Cells
(A) swell in hypotonic, shrink in isotonic
(B) swell in isotonic, shrink in hypertonic
(C) swell in hypertonic, shrink in hypotonic
(D) swell in hypotonic, shrink in hypertonic **Page – 181, Medium**

53. Plasmolysis occurs
(A) in hypotonic solution

(B) when water moves into the cell
(C) when solution has more solute than protoplasm
(D) when cell membrane becomes turgid **Page – 181, Medium**

54. When water moves out of a cell placed in hypertonic solution.
(A) water is first lost from vacuole, then cytoplasm
(B) water is first lost from cytoplasm, then vacuole
(C) water is first lost from tonoplast, then cytoplasm
(D) water is first lost from cytoplasm, then tonoplast **Page – 182, Easy**

55. Identify A, B & C in given figure.



(A) A – plasmolysed, B – isotonic, C – Turgid
(B) B – flaccid, C – hypertonic, A – Turgid
(C) A – hypotonic, C – hypotonic, B – Turgid
(D) A – turgid, B – flaccid, – hyper tonic **Page – 182, Easy**

56. The process of plasmolysis is
(A) always irreversible (B) always reversible
(C) usually reversible (D) always temporary **Page – 182, Easy**

57. Plant cells do not rupture in hypotonic solution due to
(A) turgor pressure (B) pressure potential
(C) cell membrane (D) cell wall **Page – 182, Easy**

58. What will be ψ_p of flaccid cell
(A) positive (B) negative (C) zero (D) any of the above
Page – 182, Medium

11.2.4 Imbibition

59. Imbibition
(A) Causes reduction in volume (B) is a type of active transport
(C) is along the concentration gradient (D) occurs in gases
Page – 182, Medium

11-3 Long distance transport of water

60. Bulk movement of substances through vascular tissues of plants is called
(A) Active transport (B) Facilitated diffusion
(C) Transportation (D) Translocation **Page – 183, Easy**

61. Substances in mass flow
(A) are swept at some pace in solution
(B) are swept at speed depending upon size.
(C) are swept at some pace in suspensions
(D) Both (A) and (C) **Page – 183, Easy**

62. Bulk flow is achieved by
(A) positive water pressure gradient
(B) negative water pressure gradient
(C) Both (A) and (B)
(D) It rarely depends on pressure gradient **Page – 183, Easy**

63. Xylem is associated with translocation of mainly
(i) Water (ii) organic solutes and sucrose
(iii) mineral salts (iv) organic nitrogen

(v) inorganic solute (vi) hormones
Choose correct combination
(A) i, v, iii (B) ii, vi, iv (C) iii, vi, iv (D) i, ii, iii
Page – 184, Easy

11.3.1 How do plants absorb water?

64. Absorption of water along with mineral solutes by root hairs is
(A) purely by facilitated diffusion (B) purely by diffusion
(C) purely by active transport
(D) by a combination of diffusion and active transport **Page – 184, Easy**

65. Apoplast is continuous throughout the plant, except at
(A) endodermis (B) casparian strips
(C) plasmodesmata (D) tracheids **Page – 184, Easy**

66. Apoplastic movement involves
(A) crossing the cell membrane (B) crossing the tonoplast
(C) crossing the cell wall (D) Both (a) and (c) **Page – 184, Easy**

67. Symplastic system of cells is connected through
(A) nucleoplasmic strands extending through phragmosomes
(B) nucleoplasmic strands extending through plasmodesmata
(C) cytoplasmic strands extending through phragmosomes
(D) cytoplasmic strands extending through plasmodesmata **Page – 185, Easy**

68. Cytoplasmic streaming
(A) helps in long distance transport (B) can be seen in Hydrilla leaf
(C) may be part of symplastic movement (D) Both (B) & (C)
Page – 185, Easy

69. Most of the water flow in roots occurs via
(A) symplast through living cells (B) symplast through cortical cells
(C) apoplast through intercellular spaces (D) apoplast through endodermal cells
Page – 185, Easy

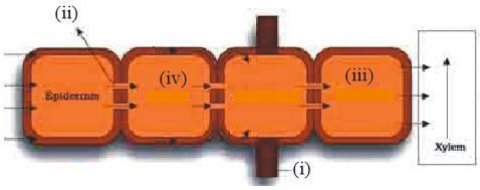
70. Water movement through root tissues
(A) can be initially symplastic and finally apoplastic
(B) has to be ultimately apoplastic
(C) can be completely apoplastic
(D) None of the above is correct. **Page – 185, Easy**

71. Read the given statements
(i) Mycorrhiza is symbiotic bacterial association of root system.
(ii) Mycorrhiza helps in water absorption.
(iii) Mycorrhiza may penetrate root cells
(iv) Mycorrhiza may from a network around young root.
Which of these statements is correct? **Page – 185-186, Difficult**
(A) 1 (B) 2 (C) 3 (D) 4

72. Which of the following statements about mycorrhiza is correct?
(A) Fungus provides N-containing compounds to plant roots.
(B) Roots provide minerals & water to mycorrhizae.
(C) Pinus seeds cannot germinate without mycorrhiza
(D) Both (A) & (C) **Page – 186, Easy**

11.3.2 Water movement a plant

73.



Identify the correct labels in given figures
(A) (i)-Cortex, (ii)-Plasmodesmata, (iii)-Endodermis, (iv)-pericycle
(B) (i)-Casparian strips, (ii)- Plasmodesmata, (iii)-Pericycle, (iv)-Cortex
(C) (i)-Cytoplasmic extension, (ii)-Cortex, (iii)-Endodermis, (iv)-Pericycle
(D) (i)-Endodermis (ii)-Cytoplasmic extension, (iii)-Cortex, (iv)-Pericycle
Page – 186, Easy

11.3.2.1 Root Pressure

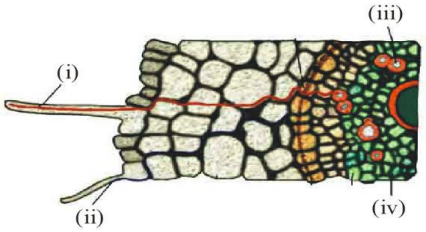
74. Root pressure is caused by
(A) active transport of ions into roots
(B) passive transport of water into roots
(C) active transport of water into roots
(D) both (A) & (B) **Page – 186, Easy**

75. Root pressure is
(A) always positive (B) always negative
(C) mostly positive (D) mostly negative **Page – 186, Easy**

76. Guttation occurs
(A) due to negative root pressure and low evaporation
(B) due to positive root pressure and low evaporation
(C) due to negative root pressure and high evaporation
(D) due to positive root pressure and high evaporation **Page – 186, Easy**

77. Root pressure contributes in
(A) majority of plant water transport
(B) transpirational pull
(C) re-establishing the continuous chain of water in xylem
(D) Both (a) & (c) **Page – 186, Easy**

78.



Identify the correct labeles for given figure.
(i) (ii) (iii) (iv)
(A) Apoplastic symplastic xylem phloem Pathway pathway
(B) symplastic apoplastic xylem phloem Pathway pathway
(C) Apoplastic symplatic phloem xylem Pathway pathway
(D) symplastic Apoplastic Phloem xylem Pathway pathway **Page – 185, Easy**

11.3.2.2 Transpiration pull

79. Which of the statements is correct?
(A) About 30% water reaching leaves is transpired
(B) About 80% water reaching leaves is transpired
(C) About 90% water reaching leaves is transpired
(D) About 99% water reaching leaves is transpired **Page – 187, Easy**

11.4 Transpiration

80. The immediate cause of opening and closing of stomata is
(A) change in CO_2 concentration
(B) change in turgidity of guard cell
(C) change in concentration in complementary cell
(D) change in water (moisture) content of air. **Page – 187, Easy**

81. Stomatal aperture is **Page – 187, Easy**
(A) cell between guard cells (B) Pore between guard cell
(C) Inner wall of guard cell (D) Inner wall of subsidiary cell

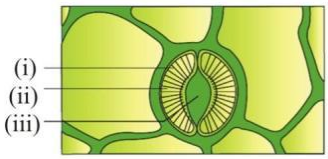
82. Inner wall of each guard cell is
(A) thin and inelastic (B) thin and elastic
(C) thick and inelastic (D) thick and elastic **Page – 187, Easy**

83. Microfibrils of cell wall of guard cell are **Page – 187, Easy**
(A) proteinaceous and radial (B) proteinaceous and longitudinal
(C) cellulosic and radial (D) cellulosic and longitudinal

84. Which of these statements about stomata opening or closing is correct?
(A) When guard cells are turgid, stoma closes
(B) When guard cells are flaccid, stoma opens
(C) When guard cells lose turgor, elastic outer walls regain their original shape and stoma closes
(D) None of these **Page – 187, Easy**

85. How many of the following are plant factors affecting transpiration?
Water status of plant, number of stomata, wind speed, light, canopy structure, humidity, temperature
(A) 7 (B) 3 (C) 4 (D) 5
Page – 187, Easy

86.



Choose the correct labels for the given figure

	(i)	(ii)	(iii)
(A)	Guard cell	Microfibril	Stomatal aperture
(B)	Microfibril	Guard cell	Stomatal aperture
(C)	Stomatal aperture	Microfibril	Guard cell
(D)	Guard cell	Stomatal	Microfibril aperture

Page – 187, Easy

87. Which of the following statements is incorrect?
(A) Cohesion is the property of xylem sap.
(B) Adhesion is the attraction of water molecules to surface of tracheary elements
(C) Adhesion is a property of xylem wall.
(D) Capillarity is the ability of water to ascend in thin tubes. **Page – 185-187, Difficult**

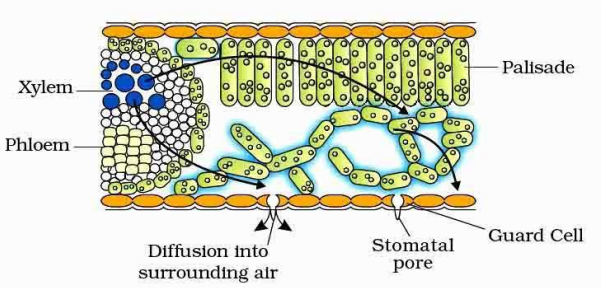
88. Water is moved from xylem to leaf cells by
(A) a push force of continuously upcoming xylem sap
(B) a push force of water incoming from phloem
(C) a pull force of cohesion between water molecules
(D) a pull force of water diffusing into air. **Page – 187, Easy**

89. Why does water diffuse into the surrounding?
(A) Due to lower concentration of water vapour in atmosphere.
(B) Due to lower concentration of water vapour in the sub-stomatal cavity.

(C) due to lower concentration of water vapour in the intercellular spaces.
(D) Due to lower concentration of water vapour in the xylem element.

Page – 187, Easy

90.



Choose correct option
(A) The figure shows water movement in a monocot leaf.
(B) The water moves due to a negative pressure created by xylem.
(C) The water moves due to a push force created by the water diffusing into surrounding
(D) The figure shows water movement in a dicot leaf. **Page – 188, Easy**

11.4.1 Transpiration & Photosynthesis – a compromise

91. Transpiration
(A) supplies water for photosynthesis
(B) decreases water available for photosynthesis
(C) has no relation with photosynthesis
(D) Both (a) & (b) **Page – 189, Easy**

92. Read the given statements
(i) Transpiration enables mineral transport
(ii) Transpiration maintains shape of plants.
(iii) Transpiration enables light absorption by plants.
(iv) Transpiration causes cooling effect.
Choose the appropriate answer
(A) Statement (i) & (ii) are correct, (iii) & (iv) are wrong
(B) Statement (iii) & (iv) are correct, (i) & (ii) are wrong
(C) Statement (i), (ii), (iii) are correct (iv) is wrong
(D) Statement (i), (ii), (iv), are correct (iii) is wrong **Page – 189, Easy**

93. Transpiration cools leaf surface by upto
(A) 2–3°C (B) 5–6°C (C) 10–15°C (D) 18–20°C
Page – 189, Easy

94. A limiting factor for photosynthesis is
(A) Water due to evaporation by high light intensity
(B) Water due to transpiration
(C) Sunlight due to cooling effect of transpiration
(D) CO_2 due to excess transpiration **Page – 189, Easy**

95. Humidity of rainforests is largely due to
(A) Cycling of nutrients from leaf to root
(B) Cycling of water from leaf to root
(C) Cycling of nutrients from root to leaf
(D) Cycling of water from root to leaf **Page – 189, Easy**

96. Read the given statements
(I) C_4 plants loses double the water lost by C_3 plant for same amount of CO_2 fixed

(II) C_4 plants are more efficient in making sugar than C_3 plants.
Choose the best option
(A) I and II are correct (B) I is correct and II is incorrect
(C) I is incorrect and II is correct (D) Both I & II are incorrect
Page – 189, Medium

11.5.1 Uptake of Mineral Ions

97. All minerals cannot be passively absorbed by roots because
(A) They are present as ions which cannot more a cross cell membrane.
(B) Concentration of minerals in soil is higher than the concentration of minerals in roots
(C) Both (a) & (b)
(D) all minerals are passively absorbed **Page – 189, Easy**

98. Which of the given statements is correct about uptake of mineral ions?
(A) Active uptake of ions is helps in uptake of water actively
(B) Passive uptake of ions helps in uptake of water actively
(C) Active uptake of ions help in uptake of water passively.
(D) Passive uptake of ions help in uptake of water passively. **Page – 189, Easy**

99. Ions are absorbed from soil by **Page – 189, Easy**
(A) active transport only (B) passive transport only
(C) mostly passive transport (D) both active & passive transport

100. The transport proteins embedded in the plasma membrane of endodermal cells
(A) allow all types of solute to pass to xylem.
(B) allow some solutes to cross the membrane
(C) shows no selectively (D) Both (a) & (c) **Page – 189, Easy**

101. Quantity & types of solute reaching xylem are decided at
(A) control points of epidermal cells as the transport starts there
(B) control point of pericycle cells as they surround the xylem
(C) control point of cortical cells as they have large intercellular spaces.
(D) control point of endodermal cells as they have specific transport proteins and suberin.
Page – 189, Easy

102. Layer of suberin present in root
(A) in cortical possess ability to passively transport ions in one direction only.
(B) can actively transport selected ions in both the directions.
(C) can transport ions actively in one direction only.
(D) can transport ions in multi directions actively **Page – 189, Easy**

11.5.2 Translocation of mineral ions

103. After the ions reach xylem, their further transport to all parts of plant is through
(A) diffusion (B) active transport
(C) translocation (D) All of the above **Page – 190, Easy**

104. Chief sinks for mineral elements are the following except **Page – 190, Easy**
(A) root hairs (B) fruits (C) seeds (D) shoot tip

105. Unloading of mineral ions occurs at the fine vein ending through (i) and uptake by cells is (ii)

	(i)	(ii)
(A)	active transport	diffusion
(B)	diffusion	actively
(C)	active transport	passive
(D)	diffusion	passive

Page – 190, Easy

106. Mineral ions are
(A) rarely remobilized, from mature parts to young parts.
(B) rarely remobilized from young leaves to old parts

(C) frequently remobilized from older parts to young parts
(D) frequently remobilized from young parts to older parts **Page – 190, Easy**

107. Elements most readily mobilized **Page – 190, Easy**
(A) phosphorous (B) potassium (C) calcium (D) both (A) & (B)

108. Most of the nitrogen travels through xylem as
(A) inorganic ions (B) inorganic complex
(C) organic compounds (D) both (a) & (b) **Page – 190, Easy**

109. Which of the following is correct
(A) most of the P and S are carried as organic compounds
(B) most of P and S are carried as inorganic compounds.
(C) Little of P and S are carried as organic compounds.
(D) Both (B) & (C) **Page – 190, Easy**

110. Read the given statements
(I) Some exchange of materials occur between xylem and phloem
(II) We cannot say that xylem transports only inorganic nutrients.
Choose the correct option.
(A) I and II both are correct and II is correct explanation for I
(B) I and II both are correct but II does not explain I
(C) I is correct and II is incorrect
(D) I and II both are incorrect **Page – 190, Medium**

11.6 Phloem Transport : Flow from source to sink

111. Which of the following statements about source and sink is incorrect
(A) Source is the part which produces food, like leaf
(B) Sink is the part which needs food
(C) Leaf can never be a sink
(D) Roots may act as a source **Page – 190, Easy**

112. Choose the correct option
(A) Movement in phloem is bidirectionalleft & right, while movement in xylem is unidirectional upward
(B) Movement in phloem is unidirectional upward while movement in xylem is bidirectional left & right
(C) Movement in phloem is bidirectional up & down while movement in xylem is unidirectional up
(D) movement in phloem is unidirectional upward while movement in xylem is bidirectional up & down. **Page – 190, Easy**

113. Phloem sap includes
(A) water, sucrose, hormones (B) sucrose only
(C) water and sucrose but no hormones
(D) sucrose and hormones but no water **Page – 190, Easy**

114. Amino acids are transported by
(A) xylem only (B) phloem only
(C) both xylem & phloem (D) neither xylem nor phloem
Page – 190, Easy

11.6.1 The pressure flow or mass flow hypothesis

115. The sugar mainly transported is
(A) Glucose (monosaccharide) (B) Glucose (disaccharide)
(C) Sucrose (disaccharide) (D) Sucrose (monosaccharide)
Page – 191, Easy

116. Glucose is converted to sucrose at
(A) the source (B) the sink

(C) midway in xylem during transport
(D) Sometimes at source and other times at sink **Page – 191, Easy**

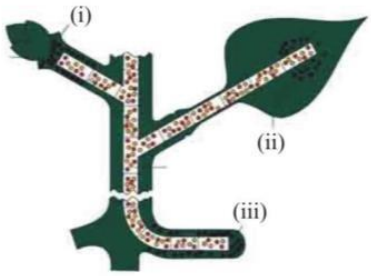
117. Select the correct pathway for sugar transport by phloem as per the mass flow hypothesis
(A) Sucrose Sieve tube Companion cells via diffusion
(B) Sucrose sieve tube companion cells via active transport
(C) Sucrose Companion cells Sieve tube via diffusion
(D) Sucrose Companion cells Sieve tube via active transport **Page – 191, Easy**

118. Loading at source during phloem translocation
(A) makes phloem hypertonic and attract water from xylem
(B) makes phloem hypotonic and attract water from xylem
(C) makes phloem hypertonic and attract water from shoot cells
(D) makes phloem hypotonic and attract water from shoot cells **Page – 191, Easy**

119. Choose the correct option for phloem transport
(A) loading is active process and unloading is passive
(B) loading is passive process and unloading is active
(C) Both loading and unloading are active
(D) Both loading and unloading are passive **Page – 191, Easy**

120. Choose the incorrect option for phloem transport
(A) transport occurs due to high osmotic pressure in phloem
(B) transport occurs due to low osmotic pressure in xylem.
(C) transport occurs due to water potential gradient
(D) transport occurs due to pressure potential gradient **Page – 191, Easy**

121.



Identify the correct match
(A) Sugar enter sieve tube, water follows by osmosis
(B) Sugar leaving sieve tube, water follow by osmosis

(i) (ii) (iii)		(i) (ii) (iii)	
(A)	A B B	(B)	B A A
(C)	A B A	(D)	B A B

Page – 191, Easy

122. Girdling experiment was used to identify
(A) tissue for water transport (B) tissue for food transport
(C) tissue for mineral transport (D) Both (A) and (C) **Page – 192, Easy**

123. In girdling experiment, a ring of bark is cut upto the depth of
(A) the xylem layer (B) the phloem layer
(C) the cortex layer (D) the endodermal layer
Page – 192, Easy

124. In girdling experiment, the stem swells
(A) above the ring, and transport is unidirectional towards roots
(B) above the ring, and transport is unidirectional towards shoot
(C) below the ring, and transport is unidirectional towards shoot
(D) Both above and below the ring, and transport is bidirectional towards root and shoot. **Page – 192, Easy**

NEET PREVIOUS YEARS QUESTIONS

1. Stomatal movement is not affected by : **[2018]**
(a) Temperature (b) Light (c) CO_2 concentration (d) O_2 concentration

2. The water potential of pure water is: **[2017]**
(a) less than zero. (b) more than zero but less than one.
(c) more than one. (d) zero.

3. Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening,carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of following options. **[2016]**
(a) Both processes cannot happen simultaneously.
(b) Both processes can happen together because the diffusion coefficient of water and CO_2 is different.
(c) The above processes happen only during night time.
(d) One process occurs during day time, and the other at night.

4. Which one gives the most valid and recent explanation for stomatal movements? **[2015]**
(a) Potassium influx and efflux (b) Starch hydrolysis
(c) Guard cell photosynthesis (d) Transpiration

5. A column of water within xylem vessels of tall trees does not break under its weight because of : **[2015]**
(a) tensile strength of water. (b) lignification of xylem vessels.
(c) positive root pressure. (d) dissolved sugars in water.

6. Root pressure develops due to: **[2015]**
(a) low osmotic potential in soil. (b) passive absorption.
(c) increase in transpiration. (d) active absorption.

7. Roots play insignificant role in absorption of water in : **[2015]**
(a) *Pistia* (b) Pea (c) Wheat (d) Sunflower

8. Transpiration and root pressure cause water to rise in plants by: **[2015]**
(a) pulling and pushing it, respectively. (b) pushing it upward.
(c) pushing and pulling it, respectively. (d) pushing it upward.

9. Xylem translocates :- **(NEET-2019)**
(1) Water only (2) Water and mineral salts only
(3) Water, mineral salts and some organic nitrogen only
(4) Water, mineral salts, some organic nitrogen and hormones

10. What is the direction of movement of sugars in phloem? **(NEET-2019)**
(1) Non-multidirectional (2) Upward (3) Downward (4) Bi-directional

11. Pinus seed cannot germinate and establish without fungal association. This is because : **(NEET-2019)**
(1) its embryo is immature (2) it has obligate association with mycorrhizae.
(3) it has very hard seed coat.
(4) its seeds contain inhibitors that prevent germination .

12. The main difference between active and passive transport across cell membrane is **(NEET-2019 ODISSA)**
(1) Passive transport is non-selective whereas active transport is selective
(2) Passive transport requires a concentration gradient across a biological membrane whereas active transport requires energy to move solutes
(3) Passive transport is confined to anionic carrier proteins whereas active transport is confined to cationic channel proteins
(4) Active transport occurs more rapidly than passive transport

13. Match the following : **(NEET-2020 COVID)**
(a) Aquaporin (i) Amide
(b) Asparagine (ii) Polysaccharide
(c) Abscisic acid (iii) Polypeptide
(d) Chitin (iv) Carotenoids
Select the correct option :
(1) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii) (2) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
(3) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii) (4) (a)-(iii), (b)-(i), (c) -(ii), (d)-(iv)

14. Select the incorrect statement. **(NEET-2020 COVID)**
(1) Transport of molecules in phloem can be bidirectional.
(2) Movement of minerals in xylem is unidirectional.

(3) Unloading of sucrose at sink does not involve the utilization of ATP.
(4) Elements most easily mobilized in plants from one region to another are: phosphorus, sulphur, nitrogen and potassium.

15. The process responsible for facilitating loss of water in liquid form from the tip of grass blades at night and in early morning is **(NEET-2020)**
1) Plasmolysis 2) Transpiration 3) Root pressure 4) Imbibition

16. Match **List – I** with **List – II.** **[NEET-2021]**

List – I		**List – II**	
(a)	Cohesion	(i)	More attraction in liquid phase
(b)	Adhesion	(ii)	Mutual attraction among water molecules
(c)	Surface tension	(iii)	Water loss in liquid phase
(d)	Guttation	(iv)	Attraction towards polar surfaces

Choose the **correct** answer from the options give below.

	(a)	**(b)**	**(c)**	**(d)**		**(a)**	**(b)**	**(c)**	**(d)**
1)	(iv)	(iii)	(ii)	(i)	2)	(iii)	(i)	(iv)	(ii)
3)	(ii)	(i)	(iv)	(iii)	4)	(ii)	(iv)	(i)	(iii)

17. Which of the following is not observed during apoplastic pathway? **[NEET-2022]**
1) Movement of water occurs through intercellular spaces and wall of the cells.
2) The movement does not involve crossing of cell membrane
3) The movement is aided by cytoplasmic streaming
4) Apoplast is continuous and does not provide any barrier to water movement.

18. "Girdling Experiment" was performed by plant physiologists to identify the plant tissue through which: **[NEET-2022]**
1) Water is transported
2) Food is transported
3) For both water and food transportation
4) Osmosis is observed

19. Addition of more solutes in a given solution will: **[NEET-2022]**
1) raise its water potential 2) lower its water potential
3) make its water potential zero 4) not affect the water potential at all

NCERT LINE BY LINE QUESTIONS – ANSWERS

1	2	3	4	5	6	7	8	9	10
C	B	A	A	B	B	B	A	D	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	B	C	B	B	A	A	B	A	C
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	A	A	A	A	C	D	B	C	D
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
A	A	C	C	A	B	B	D	C	A
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
D	B	B	A	B	A	B	A	A	A
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
B	D	C	B	A	C	D	C	C	D
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
D	C	C	B	B	C	D	D	C	D
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
C	C	B	A	A	B	B	B	D	B
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
C	D	C	D	B	B	C	D	A	D
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
A	D	C	B	D	C	A	C	D	B
101	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**
D	C	C	A	B	C	D	C	D	A
111	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**
C	C	A	C	C	A	D	A	C	B
121	**122**	**123**	**124**						
D	B	B	A						

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1 (b) **2** (d) **3** (d) **4** (a) **5** (a) **6** (d) **7** (a) **8** (a) **9** (4) **10** (4)
11 (2) **12** (2) **13** (1) **14** (3) **15** (3) **16** (4) 17 (3) 18 (3) 19 (2)

NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

1. (b) Light, temperature and concentration of CO_2 affect opening and closing of stomata. They are not Affected by O_2 concentration.

2. (d) By convention, the water potential of pure water at standard temperature, which is not under any pressure, is taken to be zero (w = 0).

3. (d) The main cause of guttation in plants is root pressure. During night, when root pressure is high sometimes due to this high pressure watery drops ooze out with the assistance of special structures which help in guttation called hydathodes.

4. (a) The opening and closing of stomata are caused by influx and efflux of potassium ions (K+). The Increase of K+ results in opening of stoma and decrease of K+ causes closing of stoma. The turgidity of guard cells induces the opening of the pores of stomata found on the surface of leaves.flux

5. (a) Due to tensile strength of water, a column of water within xylem vessels of tall trees does not break Under its weight.

6. (d) Active absorption creates root pressure. In this process, the expenditure of energy takes place for the movement of substances against concentration gradient.

7. (a) *Pistia*, a hydrophyte plant where absorption of water by root is not important.

8. (a) Transpiration creates pulling (Negative pressure) force. Root pressure creates positive pressure developed in xylem. It is measured by manometer.

15. Loss of water in liquid form from the tip of grass blades at night and in early morning is called guttation, it occurs due to root pressure

16. Cohesion – Mutual attraction among molecules water
Adhesion – Attraction towards surface polar
Surface tension – More attraction in liquid phase
Guttation – water loss in liquid phase

17. The movement is Aided by cytoplasmic streaming is not observed during apoplast pathway instead observed during SYMPLAST pathway

18. A simple experiment, called girdling, was used to identify the tissues through which food is transported

19. More the solutes is leaser the Ψ_s.
Solutes lowers the osmotic potential and water potential