

Transport in Plants

Multiple Choice Questions (MCQs)

Q. 1 Which of the following statements does not apply to reverse osmosis?

- (a) It is used for water purification
- (b) In this technique, pressure greater than osmotic pressure is applied to the system
- (c) It is a passive process
- (d) It is an active process

💡 Thinking Process

Osmosis is special type of diffusion of water molecules across a semipermeable membrane from a region of higher concentration to that of a lower concentration. The net direction and rate of osmosis depends on pressure and concentration gradient.

Ans. (d) Reverse osmosis is not an active process. A process (in organisms) is considered active when its completion requires energy in form of ATP. And as reverse osmosis does not consume ATP, it is a passive process, though external pressure is applied in order to carry out osmosis in a reverse direction (lower to higher).
Rest of the options are true for reverse osmosis.

Q. 2 Which one of the following will not directly affect transpiration?

- (a) Temperature
- (b) Light
- (c) Wind speed
- (d) Chlorophyll content of leaves

Ans. (d) Chlorophyll content will not affect the rate of transpiration.
Options (a), (b) and (c) all affect the rate of transpiration.

- (a) **Temperature** increases the rate of transpiration.
- (b) **Light quality** and intensity also affect the rate of this phenomenon.
- (c) **Wind speed** higher the wind speed, more will be the rate of transpiration.

Q. 3 The lower surface of leaf will have more number of stomata in a

- (a) dorsiventral leaf
- (b) isobilateral leaf
- (c) Both (a) and (b)
- (d) None of these

Ans. (a) In dorsiventral leaf, the number of stomata will be more on lower surface. This feature enhances gas exchange between leaf surface and the atmosphere for the processes of photosynthesis and respiration.

Whereas in isobilateral leaf, stomata are uniformly distributed on both the surfaces.

Q. 4 The form of sugar transported through phloem is

- (a) glucose (b) fructose (c) sucrose (d) ribose

💡 Thinking Process

Glucose is the first product of photosynthesis in plant and also is the source of energy for every cell. Plants cannot transport it to the other cell as such because it is an reactive molecule.

Ans. (c) Sucrose a disaccharide sugar is transported through phloem. It comprises of 2 units of glucose joined by α -1-4 linkage. It is the most inactive form of sugar so used in the transport of food.

Glucose because of presence of CHO group is reactive sugar.

Fructose is founds in fruits and ribose is present in nucleic acids.

Q. 5 The process of guttation takes place

- (a) when the root pressure is high and the rate of transpiration is low.
(b) when the root pressure is low and the rate of transpiration is high.
(c) when the root pressure equals the rate of transpiration.
(d) when the root pressure as well as rate of transpiration are high.

Ans. (a) Guttation occurs when root pressure is high and rate of transpiration is low and there is high humidity in the air.

The other given conditions do not favour guttation.

Q. 6 Which of the following is an example of imbibition?

- (a) Uptake of water by root hair (b) Exchange of gases in stomata
(c) Swelling of seed when put in soil (d) Opening of stomata

💡 Thinking Process

Imbibition is a physical phenomenon. Water is absorbed by the surface of seed and other biological materials.

Ans. (c) Swelling of seed in soil is an example of imbibition. Imbibition is a type of diffusion process along the concentration gradient enabling the solid to absorb water and increase in volume. When seed is put in the soil it absorbs water which activate enzymes present in seed and this induces the seed germination.

The other options, i.e., uptake of water by root hair is an example of absorption, exchange in of gases stomata is an example of diffusion and opening of stomata is an example of turgor pressure or turgidity.

Q. 7 When a plant undergoes senescence, the nutrients may be

- (a) accumulated (b) bound to cell wall
(c) translocated (d) None of these

Ans. (c) Senescence is the programmed death of a plant. Translocation of nutrients to different parts of the plant are withdrawn at the time of senescence.



Q. 8 Water potential of pure water at standard temperature is equal to

- (a) 10 (b) 20 (c) zero (d) None of these

Ans. (c) Water potential of pure water at standard temperature is zero. It is the highest value of water potential.

Q. 9 Choose the correct option mycorrhiza is a symbiotic association of fungus with root system which helps in

- A. absorption of water B. mineral nutrition
C. translocation D. gaseous exchange

Codes

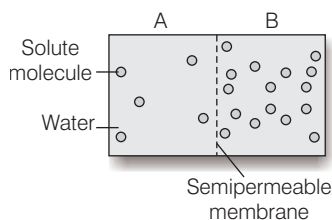
- (a) Only A (b) Only B (c) Both A and B (d) Both B and C

Thinking Process

Symbiosis is a phenomenon in which two organisms are associated with each other in such a way that both of them derive benefit from each other.

Ans. (c) Mycorrhiza associated with roots of plants helps in both absorption of water and minerals from the soil. The other options are incorrect.

Q. 10 Based on the figure given below which of the following statements is not correct?



- (a) Movement of solvent molecules will take place from chamber A to B
(b) Movement of solute will take place from A to B
(c) Presence of a semipermeable is a pre-requisite for this process to occur
(d) The direction and rate of osmosis depends on both the pressure gradient and concentration gradient

Ans. (b) Movement of water will take place from chamber A to B. It is not the solute which will move from chamber A to B. The is because osmosis is a process in which solvent molecules moves from a region of higher concentration to a region of lower concentration through a semi-permeable membrane.

Q. 11 Match the followings and choose the correct option.

| Column I | Column II |
|---------------------|----------------------------------|
| A. Leaves | (i) Anti-transpirant |
| B. Seed | (ii) Transpiration |
| C. Roots | (iii) Negative osmotic potential |
| D. Aspirin | (iv) Imbibition |
| E. Plasmolysed cell | (v) Absorption |

Codes

- (a) A-ii, B-iv, C-v, D-i, E-iii (b) A-iii, B-ii, C-iv, D-i, E-v
(c) A-i, B-ii, C-iii, D-iv, E-v (d) A-v, B-iv, C-iii, D-ii, E-i

Ans. (a) The correct matched sequence of the two columns is as follows.

| | | |
|------------------|---|----------------------------|
| Leaves | – | Transpiration |
| Seed | – | Imbibition |
| Roots | – | Absorption |
| Aspirin | – | Anti-transpirant |
| Plasmolysed cell | – | Negative osmotic potential |

Q. 12 Mark the mismatched pair.

| | |
|-----------------|---|
| A. Amyloplast | (i) Store protein granule |
| B. Elaioplast | (ii) Store oils or fats |
| C. Chloroplasts | (iii) Contain chlorophyll pigments |
| D. Chromoplasts | (iv) Contain coloured pigments other than chlorophyll |

💡 Thinking Process

Plants have plastids as an cell organelles. They are of three types chromoplasts, chloroplasts and leucoplasts (amyloplast).

Ans. (a) Amyloplasts are the colourless plastids which store starch but not the protein granules. Other pairs are correctly matched.

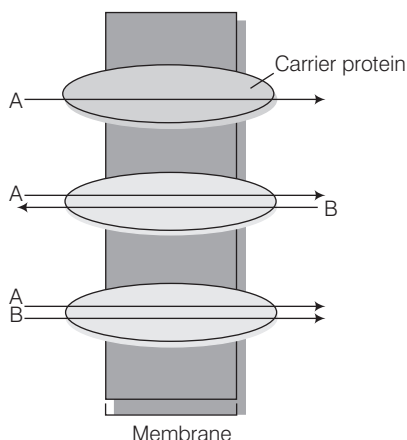
Very Short Answer Type Questions

Q. 1 Smaller, lipid soluble molecules diffuse faster through cell membrane, but the movement of hydrophilic substances are facilitated by certain transporters which are chemically

💡 Thinking Process

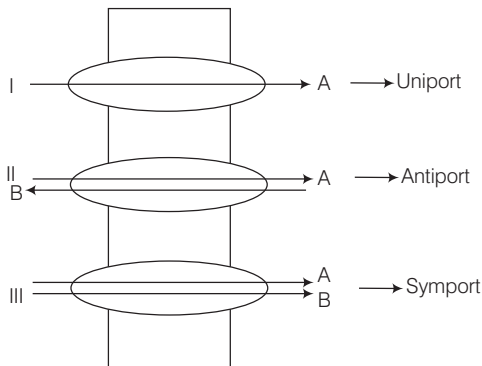
The movement of substances across the limiting membrane in a living cell is a highly specific and regulated phenomenon. This regulation is done mainly by membrane proteins.

Ans. Proteins.



The movement of hydrophilic substances are facilitated by transporters which are chemically proteins. These proteins form porins, which are huge pores in the outer membranes of the plastids, mitochondria and some bacteria. These porins allow the small molecules to pass through the membrane.

Q. 2 In a passive transport across a membrane. When two protein molecules move in opposite direction and independent of each other, it is called as



Ans. Antiport This process facilitates transport of molecules in both the directions across the membrane and their movement is independent of each other.

Q. 3 Osmosis is a special kind of diffusion, in which water diffuses across the cell membrane. The rate and direction of osmosis depends upon both

💡 Thinking Process

Osmosis is an important biological phenomenon in the living world. It is governed by number of factors.

Ans. The rate and direction of osmosis depends upon both the **pressure gradient** and **concentration gradient**.

Q. 4 A flowering plant is planted in an earthen pot and irrigated. Urea is added to make the plant grow faster, but after sometime the plant dies. This may be due to

Ans. The plant dies due to exosmosis. As the solution outside the plant is an hypertonic solution, and the plant cells are hypotonic in nature, so there is a gradual movement of water from plant cell to outside urea solution leading to plasmolysis of root cells and plant dies gradually.

Q. 5 Absorption of water from soil by dry seeds increases the, thus helping seedlings to come out of soil.

💡 Thinking Process

Seeds usually have colloid substances which absorb and adsorb lot of water when it is available to them and show significant swelling and increase in size.

Ans. Due to imbibition of water by seed materials (starch and protein), pushes the seedlings out of the soil, thus the seed swells and imbibition pressure increases inside the seed, which contributing for germination of seeds.

Q. 6 Water moves up against gravity and even for a tree of 20 m height, the tip receives water within two hours. The most important physiological phenomenon which is responsible for the upward movement of water is

Ans. **Transpiration pull** is the physiological phenomenon which is responsible for the upward movement of water in trees of height up to 20m. As the water molecules transpire from stomata, it pulls water molecules up ward to the leaf from the continuous chain of water molecules carried by xylem.

This transpiration from leaf creates a pressure gradient between the atmosphere and sub-stomatal cavity and intercellular spaces of leaf. This gradient is transferred to photosynthetic cells and then on to xylem of leaf vein.

It results in a force called "transpirational pull" that can lift water upto 130m high, through a xylem column.

Q. 7 The plant cell cytoplasm is surrounded by both cell wall and cell membrane. The specificity of transport of substances are mostly across the cell membrane, because

Ans. The transport takes place by the cell membrane because **cell membrane** is semi-permeable and composed of lipids that are arranged in bilayer structure along with proteins and carbohydrate.

The lipid soluble molecules pass readily across lipid bilayer of cell membrane whereas movement of other molecules of small size is facilitated by porins, pores made up of proteins. While cell wall does not helps in transport of substances because it.

Cell wall is basically a non-living rigid structure forming outer covering over plasma membrane and it provides shape, mechanical strength and protection to the plant cell from damages and infection.

Q. 8 The C_4 plants are twice as efficient as C_3 plants in terms of fixing CO_2 but lose only as much water C_3 plants for the same amount of CO_2 fixed.

Ans. Half, The evolution of the C_4 or plants photosynthetic system is probably one of the strategies for maximising the ability of CO_2 while minimising water loss. C_4 plants are twice as efficient as C_3 plants in terms of fixing carbon in the form of glucose, but lose only half as much water as a C_3 plant for the same amount of C_2 fixed.

Q. 9 Movement of substances in xylem is unidirectional while in phloem it is bidirectional. Explain

💡 Thinking Process

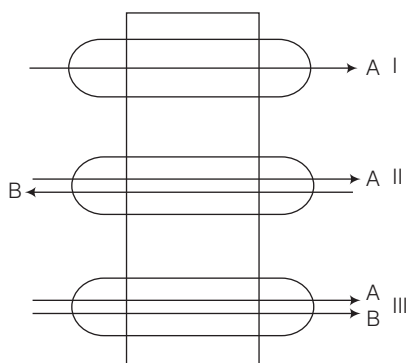
Xylem and phloem are complex permanent tissues found in vascular plants (gymnosperms and angiosperms).

Ans. **Xylem** is involved in the one way transport of water and minerals from soil to root → stem → leaves. Several forces act in this mechanism like imbibition, root pressure and finally transpiration pull. There is continuous loss of water at the body surface of plants. Thus, it is a unidirectional process.

Phloem's main function is to transport food from source to sink where source implies with the part of plant responsible for synthesising food and sink to those parts and organs that needs or consumes food for their growth and development. These source and sink parts of a plants may vary in different phases of its growth, thus the food need to travel in both upwards and downward direction. So, phloem shows bidirectional movement of substances.



Q. 10 Identify the process occurring in I, II and III



💡 Thinking Process

Facilitated diffusion involves special proteins that help in moving substances across membranes without the expenditure of energy, i.e., ATP.

- Ans.**
- I. **Uniport** In this process, there is movement of a molecule across a membrane, i.e., of other molecules.
 - II. **Antiport** In this process, there is a movement of two types of molecules in opposite direction.
 - III. **Symport** In this process, there is a movement of more than one molecule across the membrane in the same direction, at one time.

Q. 11 Given below is a table. Fill in the gaps.

| Property | Simple Diffusion | Facilitated Transport | Active Transport |
|------------------|------------------|-----------------------|------------------|
| Highly selective | No | Yes | — |
| Uphill transport | — | — | Yes |
| Requires ATP | — | — | — |

Ans.

| Property | Simple Diffusion | Facilitated Transport | Active Transport |
|------------------|------------------|-----------------------|------------------|
| Highly selective | No | Yes | Yes |
| Uphill transport | No | No | Yes |
| Requires ATP | No | No | Yes |

Active Transport It uses energy to pump molecules against a concentration gradient. Hence, different proteins in the membrane play a major role in active transport. Carrier protein involved in active transport is very specific in what it carries across the membrane.

Facilitated Transport In facilitated transport special proteins help in movement of substances across the membrane without the expenditure of ATP. Facilitated transport is very specific as it allows cell to select substances for uptake.

Simple Diffusion It is a physical phenomenon which involves the movement of water from higher concentration to lower concentration. It is not a selective process and do not require energy.

Q. 12 Define water potential and solute potential.

Ans. Water potential is a measure of free energy associated with water per unit volume (JM^{-3}). The water potential of pure water (ψ_w) at atmospheric pressure is zero. The unit of water potential is bars or Pascal ($1 \text{ mPa} = 10 \text{ bars}$).

Solute Potential The addition of solutes reduce water potential (to a negative value). This reduces the concentration of water. Hence, solutions have a lower water potential than pure water, the magnitude of this lowering due to dissolution of a solute is called **solute potential** or ψ_s .

Q. 13 Why is solute potential always negative? Explain $\psi_w = \psi_s + \psi_p$.

Ans. If some solute is dissolved in pure water, solution has fewer free water molecules and the concentration of water decreases, reducing its water potential.

Hence, all the solutions have a lower water potential than pure water. The magnitude of this lowering is due to dissolution of solute is called solute potential or ψ_s . ψ_s is always negative. The more the solute molecules, the lower (more negative) is the solute potential ψ_s water potential of a cell is affected by both solute and pressure potential.

The relationship can be illustrated as

$$\psi_w = \psi_s + \psi_p$$

Where,

ψ_w = water potential,

ψ_s = solute potential,

ψ_p = pressure potential.

Q. 14 An onion peel was taken and

- (a) placed in salt solution for five minutes.
- (b) after that it was placed in distilled water.

When seen under the microscope what would be observed in (a) and (b)?

Thinking Process

Onion is a modified stem which is called bulb. The leaves become thick, fleshy, scaly and store food materials. The epidermis in them is very thin and good object to study the water related experiments.

Ans. (a) Onion peel when placed in salt solution, shrinks as water from cells cytoplasm moves out of the cell i.e., hypertonic solution.

(b) When it is placed again back in distilled water, cell regains its shape and absorbs water and become turgid (full of water) i.e., hypotonic solution.

Q. 15 Differentiate between apoplast and symplast pathways of water movement. Which of these would need active transport?

Ans. Difference between apoplast pathway and symplast pathway is as follows

| Apoplast Pathway | Symplast Pathway |
|--|--|
| It consists of the non-living parts of plant body, i.e., cell walls and inter cellular spaces. | It consist of living parts of plant body, i.e., protoplast connected by the plasmodesmata. |
| There is a little resistance in the movement of water in apoplastic pathway. | Some resistance occurs in the movement of water through symplast. |
| It is a faster process. | It is a slightly slower process. |



Q. 16 How does most of the water moves within the root?

💡 Thinking Process

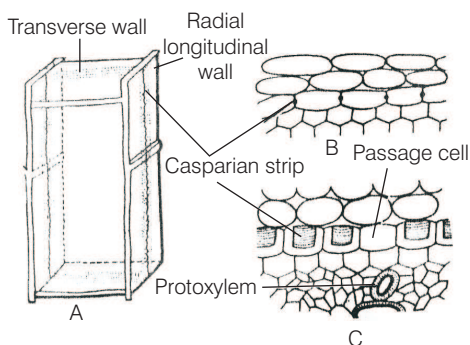
The responsibility of absorption of water and minerals is more specifically the function of the root hairs that are present in millions in the root hair zone.

Ans. Most of the water flow in the root occur via the apoplast pathway since, the cortical cells are loosely packed and hence offer no resistance to water movement, which is through mass flow. This mass flow of water occurs due to adhesive and cohesive properties of water.

However, symplast pathway is also involved in the movement of water molecules within the root (i.e., via endodermis to xylem).

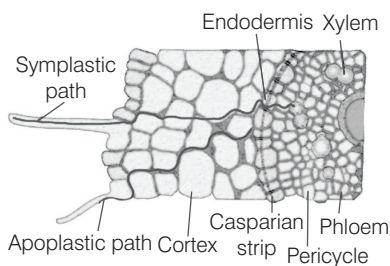
Q. 17 Give the location of casparian strip and explain its role in the water movement.

Ans. Casparian strip is found in the endodermis. The walls of this layer are impervious to water because of the presence of suberin. So, it does not allow movement of water across the endodermis, rather is forced to enter the symplast pathway through cell membranes and reaches the xylem.



Casparian strips and passage cells in the endodermis

A. Endodermal cell to shown casparian strip
B. and C. Endodermal cells in TS P=Passage cell



Symplastic and apoplastic pathways of water and ion absorption and movement in roots

Q. 18 Differentiate between guttation and transpiration.

Ans. *Difference between guttation and transpiration is as follows*

| Guttation | Transpiration |
|---|---|
| Guttation is the loss of liquid droplets from the plants. | It is the loss of water by a plant in the form of vapours. |
| Guttated water is a dilute solution of both inorganic and organic substances. | Transpired water is a pure water. |
| Guttation occurs at the margins and the tips of the leaves. | Transpiration occurs through the general surface of the leaves and the young stem. |
| Excessive guttation does not cause loss of turgidity. | Excessive transpiration results in wilting in severe cases, could be lethal to plant. |

Q. 19 Transpiration is a necessary evil in plants. Explain

💡 Thinking Process

Loss of water in the form of water vapours from the surface of leaves of plant is called transpiration.

Ans. **Transpiration a Necessary Evil**

The plant continuously lose water in the vapour form from its body surfaces. It creates a transpiration pull to absorb more and more water from soil through roots.

If the plant does not get water in soil, even then loss through transpiration is not stopped, so plant shows wilting sometimes it leads to the physiological wilting (non-recoverable) and plant dies. So, the transpiration is necessary evil.

Q. 20 Describe briefly the three physical properties of water which helps in ascent of water in xylem.

💡 Thinking Process

Water is a chemical substance which has chemical formula H_2O . Two hydrogen atoms attach to O_2 with covalent bonds.

Ans. *The three physical properties of water that helps in ascent up to xylem are as given*

| | |
|---------------------|---|
| Cohesive properties | Mutal attraction between molecules |
| Adhesive properties | Attraction of water molecules to polar surfaces (of tracheids) |
| Surface tension | Water molecules get attracted to each other more in liquid phase than in gas phase. |

Q. 21 A gardener forgot to water a potted plant for a day during summer, what will happen to the plant? Do you think it is reversible? If yes, how?

💡 Thinking Process

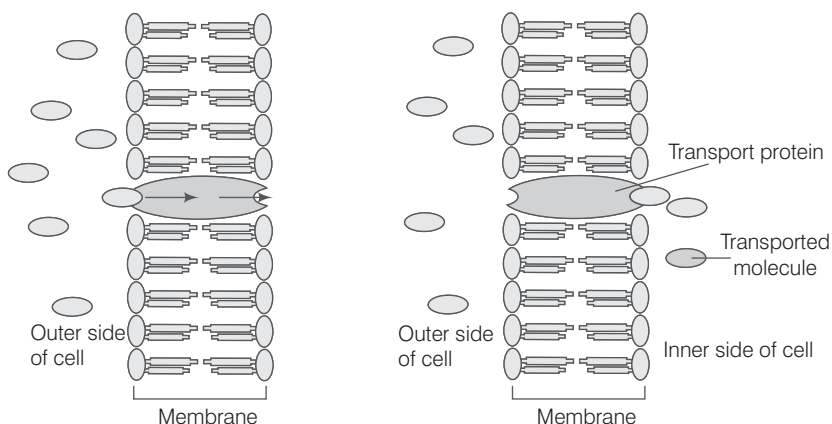
No living being (plant or animal) can survive without water.

Ans. If gardener forgets to water the plants, it will start it wilting (a physiological state of plant in which plant leaves droop down). If watered in time, the plant may recover and become normal.

But in second condition, if watering is delayed, the plant will not recover as if it reaches at physiological wilting stage, it will not recover and dies.



Q. 22 Identify a type of molecular movement which is highly selective and requires special membrane proteins, but does not require energy.



Ans. Facilitated diffusion is the mechanism which is highly selective passive process. In facilitated diffusion special proteins help in movement of substances across the membrane without expenditure of ATP energy because facilitated diffusion causes net transport of molecules from a low to high concentration and this would not require input of energy.

Q. 23 Correct the statements.

- Cells shrink in hypotonic solutions and swell in hypertonic solutions.
- Imbibition is a special type of diffusion when water is absorbed by living cells.
- Most of the water flow in the roots occurs *via* the symplast.

Ans. (a) The cell **swell** in hypotonic solution and **shrink** in hypertonic solution.
 (b) Imbibition is a special type of diffusion when water is **adsorbed** by living cells.
 (c) Most of the water flow in roots occurs *via* the apoplast way.

Short Answer Type Questions

Q. 1 Minerals absorbed by the roots travel up the xylem. How do they reach the parts where they are needed most? Do all the parts of the plant get the same amount of the minerals?

Ans. The minerals absorbed are transported up the stem, to all parts of plant through the **transpiration stream**. The chief **sinks** for the mineral elements are the growing region of the plant, such as the **apical** and **lateral meristems**, young leaves, developing flowers, fruits, seeds and the storage organs.

Unloading of the mineral ions occurs *via* fine vein endings through diffusion and active uptake by the cells. In plants, xylem are involved in transport of inorganic nutrients where phloem transport only organic materials.

Mineral ions are frequently remobilised from older parts of plant like leaves to the younger regions. Elements most readily mobilised are **phosphorus, sulphur, nitrogen, potassium**, and **some elements** that forms the structural component are not remobilised e.g., calcium.

Q. 2 If one wants to find minerals and in the form they are mobilised in the plant, how will an analysis of the exudate help?

Ans. The plant exudate (plant sap) is a mixture of the organic/inorganic compounds and ions, minerals, sugars and amino acids. If we chemically analyse these we can get to know which mineral nutrient is transported in which form in the plants. e.g., nitrogen is absorbed and transported as NO_2^- and NO_3^- and sulphur in sulphate ion forms etc.

Q. 3 From your knowledge of physiology can you think of some method of increasing the life of cut plants in a vase?

Ans. The life of cut plant in a vase can be increased by placing them in water immediately as air will rapidly move into the water conducting tissue and plug the cell. Also, providing nutrients and elements in a varied concentration can increase the life span of plants.

One phytohormone called cytokine can also be sprayed or plants can be dipped in the solution, as it delays the senescence of plant.

Q. 4 Do different species of plant growing in the same area show the same rate of transpiration at a particular time? Justify your answer.

Ans. The rate of transpiration depends on number of factors. If the two species are related and have similar morphology then only external factors will determine the rate of transpiration like wind velocity, humidity temperature, light intensity etc.

Q. 5 Water is indispensable for life. What properties of water make it useful for all biological processes on the earth?

Thinking Process

Water is indispensable for life. No life on earth is possible without water. It is required by all organisms in performing vital functions, in plants water is required for the manifestation of its various vital activities.

Ans. Properties of water that make it useful for all biological processes on the earth are

- (i) Water is the major solvent through which mineral nutrients enter a plant from the soil solution.
- (ii) It is an ideal solvent with neutral pH.
- (iii) Water is the major constituent of protoplasm. It constitutes approximately 90% of the protoplasm.
- (iv) Water acts as a medium for translocation of nutritive substances. Mineral nutrients are absorbed by the roots. Carbohydrates that are formed during photosynthesis are transported by water from cell to cell, tissue to tissue and organ to organ.
- (v) In plants, water is involved in photosynthesis by incorporating hydrogen atom into carbohydrate and oxygen atoms are further released as O_2 .
- (vi) Water acts as agent for temperature control. The specific heat of water helps plant in maintaining a relatively stable internal temperature.
- (vii) In some plants water is necessary for pollination. Like in bryophytes and pteridophytes, they essentially require water for the fertilisation process.

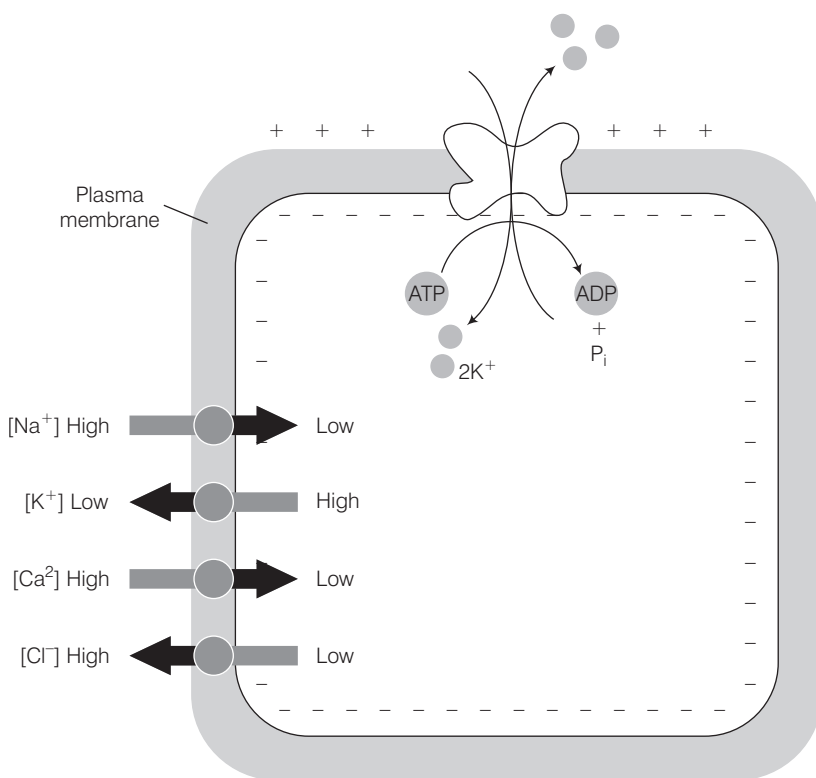


Q. 6 How is it that the intracellular levels of K^+ are higher than extracellular levels in animal cells?

💡 Thinking Process

*The excitability of sensory cells, neurons and muscles depends on ion channels, signal **transducers** that provide a regulated path for the movement of inorganic ions such as Na^+ , K^+ , Ca^{2+} , and Cl^- across the plasma membrane in response to various stimuli.*

Ans. Ion channels are 'gated', i.e., they may be open or closed. The Na^+ , K^+ , ATPase create a charge imbalance across the plasma membrane by carrying $3Na^+$ out of the cell for every $2K^+$ ion carried inside making the inside negative relative to outside. The membrane is said to be polarised. That is the reason the intracellular levels of K^+ are higher than extracellular levels in animal cells.



Showing ion balance in animal cell

Q. 7 Cut pieces of beetroot do not leave the colour in cold water but do so in hot water. Explain.

Ans. Cut pieces of beetroot do not leave colour in cold water but do so in hot water because pigment of beetroot dissolve and diffuse readily in hot water as hot temperature help in leaking of the plasma membrane and release of beetroot pigment.

Q. 8 In a girdled plant, when water is supplied to the leaves above the girdle, leaves may remain green for sometime then wilt and ultimately die. What does it indicate?

Ans. In a girdled plant, when water is supplied to the leaves above the girdle, leaves may remain green for sometime because leaves can synthesise their own carbohydrate food through photosynthesis, then wilt due to non-availability of water.

The system of xylem vessels from root to the leaf vein can supply the needed water, during girdling there is a possible loss of xylem vessels and the water supply cuts off, resulting in death of plant.

Q. 9 Various types of transport mechanisms are needed to fulfil the mineral requirements of a plant. Why are they not fulfilled by diffusion alone?

Ans. Various types of ions, minerals and organic compound are transported in plants in various modes, e.g.,

- (i) Food substances synthesised in leaves are translocated downward towards root and stem.
- (ii) Similarly food is translocated upwards to the developing leaves, buds and fruits.
- (iii) Radial transport of food occurs across the stem from the cells of pith, from cortex etc, towards epidermis.
- (iv) Ions and minerals are transported upwards through xylem.

Since, diffusion is a slow process and allows movement of molecules for short distances only, it cannot fill and alone carry out the above mentioned movements of organic and inorganic substances. Therefore, a need arises for special long distance transport systems that permits and move substances at a much faster rate, i.e., mass or bulk flow system through conducting tissues (translocation).

Q. 10 How can plants be grown under limited water supply without compromising on metabolic activities?

Ans. Under conditions of limited water supply, plants reduce the loss of water through transpiration by shutting down stomata. But they carry out the important life processes like photosynthesis, respiration and transport of food, etc.

Q. 11 Will the ascent of sap be possible without the cohesion and adhesion of the water molecules? Explain.

Ans. No, the ascent of sap is not possible without the cohesive and adhesive properties of water as they play an important role in transport of water because of the following reasons

- (i) Cohesion forces hold together the water molecule in the conducting channels, so vacuum is not created.
- (ii) Adhesive forces between the water molecule and cellulose of cell wall make a thin film of water along the channels so, this film can be pulled up by transpiration pull drawing more and more water upwards in the conducting channels from the root.

Q. 12 Keep some freshly cut flowers in a solution of food colour. Wait for sometime for the days to rise in the flower, when the stem, of the flower is held up in light, coloured strands can be seen inside. Can this experiment demonstrate which tissue is conducting water up the stem?

Ans. Yes, it shows that xylem tissue conducts water.



Q. 13 When a freshly collected *Spirogyra* filament is kept in a 10% potassium nitrate solution, it is observed that the protoplasm shrinks in size

(a) What is this phenomenon called?

(b) What will happen if the filament is replaced in distilled water?

Ans. (a) Plasmolysis is the name of the phenomenon, occurring in *Spirogyra* filament when placed in 10% potassium nitrate solution (hypertonic solution). It occurs as water from the cell is drawn out to extracellular fluid causing the protoplast to shrink away from cell wall.

(b) When the *Spirogyra* again reabsorb water, protoplast will again and will come back in its original shape. This phenomenon is known as deplasmolysis.

Q. 14 Sugar crystals do not dissolve easily in ice cold water. Explain.

Ans. Pure water has tremendous free energy at normal room temperature. That is called water potential. When the water temperature drops down, the free energy is reduced so, sugar does not get dissolved easily in, i.e., cold water.

Q. 15 Salt is applied to tennis lawns to kill weeds. How does salting tennis lawns help in killing of weeds without affecting the grass?

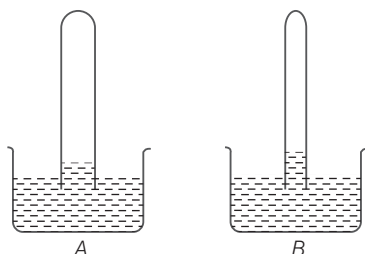
Ans. Salt solution being hypertonic, causes exo-osmosis in plants. 1 cup salt in 2 cup of water, fairly well dissolved when sprayed on weed plants, start killing them. This salt concentration is then increased in subsequent sprays, if the weeds are still thriving in the field.

Q. 16 What is the chemical composition of xylem and phloem sap?

Ans. **Xylem sap** consists of mainly water and some solutes or mineral nutrients.

Phloem sap mainly consists of the sucrose, a kind of transport sugar which is a disaccharide, hormones and amino acids are also found in phloem sap of the plants.

Q. 17 If you are provided with two tubes (A and B), where one is narrow and the other is relatively wider and if both are immersed in a beaker containing water as shown in the figure.



Why does B show higher water rise than A?

Ans. The tube B will show higher level than tube A because of the capillary action.

Q. 18 What are 'aquaporins'? How does presence of aquaporins affect osmosis?

💡 Thinking Process

Peter Agre was awarded Nobel Prize in chemistry (2003) for discovering Aquaporins.

Ans. **Aquaporins** are integral membrane proteins. These form pores or channels in the membrane. The water can flow more rapidly through these pores to inside of the cell, as compared to the process of diffusion.

These are plumbing systems of the cells. These selectively conduct water in and out of the cells, while preventing the passage of ions and other solutes.

Q. 19 ABA (Absciscic Acid) is called a stress hormone.

A. How does this hormone overcome stress conditions?

B. From where does this hormone get released in leaves?

Ans. A. Stress hormone ABA (Absciscic Acid) gives signals to stomata to get closed, whenever there is scarcity of availability of water to the plant. This prevents the loss of water through transpiration by leaves. It also increases the tolerance of plants to various kinds of stresses.

B. It (ABA) is released or transported from stem apices to leaves.

Q. 20 We know that plants are harmed by excess water. But plants survive under flooded condition. How are they able to manage excess water?

Ans. Plants can get rid of excess water by increasing the transpiration rate but upto a certain limit. Prolong water logged conditions for roots may lead to the death of the plant (as they can not respire).

Q. 21 Differentiate between diffusion and translocation in plants.

Ans. *Difference between diffusion and translocation in plants is as follows*

| Diffusion | Translocation |
|--|--|
| It is the movement of solute from higher concentration to lower concentration. | It is movement of organic compounds mineral salts from one part of the plant to another. |
| No energy consumption involved. | It is energy consuming process. |

Q. 22 How is facilitated diffusion different from diffusion?

Ans. *Difference between diffusion and facilitated diffusion is as follows*

| Diffusion | Facilitated Diffusion |
|--|--|
| In diffusion , molecules move in a random fashion, the net result being substances moving from regions of higher concentration to regions of lower concentration. Diffusion is a slow process and is not dependent on a 'living system'. No expenditure of energy takes place. | The diffusion of substance against a concentration gradient, which is facilitated by the proteins is known as facilitated diffusion without expenditure of ATP energy. The porins proteins that form huge pores in the outer membranes of the plastids, mitochondria and some bacteria allow molecules up to the size of small proteins to pass through. |

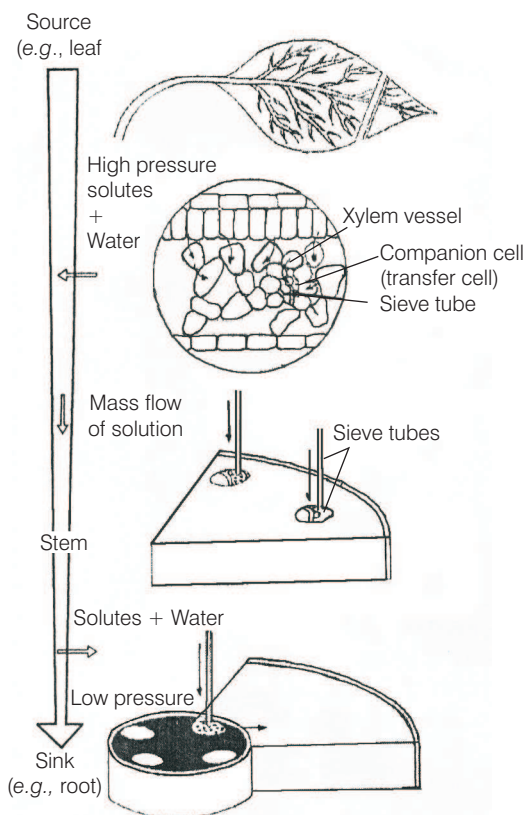


Q. 23 Explain the mass flow hypothesis of transport in phloem.

Ans. Mass flow hypothesis was first proposed by Ernst Munch (1930). It explains the transport of solute or sugars, *i.e.*, sucrose in the phloem tissue.

It involves the following three steps

- (a) Phloem loading
- (b) Translocation of solutes
- (c) Phloem unloading



Movement of solutes such as sucrose through the phloem of a plant

Loading of sieve tubes takes place in leaves. Photosynthetic cells make sugars, particularly sucrose, and other organic solutes.

Companion cells use energy to collect solutes by active transport. As solute concentration increases in the companion cells, water enters by osmosis.

A pressure is created, which pushes the solutes through plasmodesmata into the sieve tubes. It is an active process.

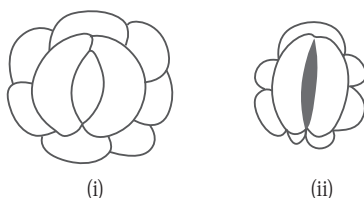
Translocation of sucrose takes place through phloem column. Increase in hydrostatic pressure inside sieve tubes is greatest at the source and lowest at the sink. It pushes sucrose etc., from source to sink.

Unloading of the sieve tubes takes place at the sink sites.

It results in active transport of sugars out of the phloem converting them into complex sugars. Loss of solutes from the phloem create a high water potential, and water moves out of phloem, returning back to xylem.

Sinks are the regions where solutes *i.e.*, sugars or food are being used, *e.g.*, roots, fruits, storage organs and regions of growth.

Q. 24 Observe the diagram and answer the following.



- (a) Are these types of guard cells found in monocots or dicots?
- (b) Which of these shows a higher water content (i) or (ii)?
- (c) Which element plays an important role in the opening and closing of stomata?

Ans. (a) The guard cells are bean-shaped which are found in dicot plants.

(b) The guard cells in figure (i) are turgid as, they pull the inner wall of the cell outside thus, they have more water. (ii) cells are flaccid, this condition results when cells lose water and close stomatal pore.

(c) The K^+ ions when move from neighbouring cells to guards cells, lowering their water potential as a result the water moves inside making them turgid and thus opening stomata.

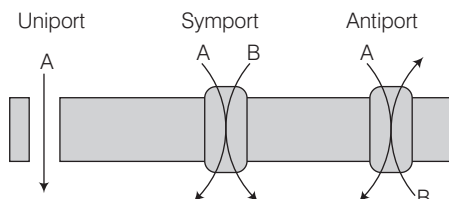
Q. 25 Define uniport, symport and antiport. Do they require energy?

Ans. The biological membranes have many mechanism for movement of substances to and for. Some are active and some are passive. Specific membrane proteins are also involved for special types of transport mechanisms.

Uniport This is a membrane transport system by a integral membrane protein that is involved in facilitated diffusion. These channels get open in response to a stimulus for free flow of specific molecules in a specific direction. These transport molecule with solute gradient without energy expenditure.

Symport This involves the movement of two or more different molecules or ions, across the membrane in the same direction, with no energy expenditure.

Antiport also called exchanger. This integral membrane protein is involved in secondary active transport of two or more different molecules or ions across the membrane in opposite directions, without affecting the transport of other molecules.



Long Answer Type Questions

Q. 1 Minerals are present in the soil in sufficient amounts. Do plants need to adjust the type of solutes that reach the xylem? Which molecules help to adjust this? How do plants regulate the type and quantity of solutes that reach xylem?

Ans. Yes, plants need to adjust the type and quantity of solutes that reach the xylem. The transport proteins of endodermal cell help in maintaining and adjusting solute movement. As the minerals are present in soil as charged particles with a very low concentration as compared of roots, they, all cannot be completely passively transported across cell membranes of root hairs.

Thus, minerals are transported both by active and passive processes, to the xylem. Upon reaching xylem, they are further transported, *i.e.*, upwards to sinks through transpiration stream. At the sink regions mineral ions are unloaded through diffusion and active uptake by receptor cells.

Some of the mineral ions moving frequently through xylem are

- (i) **Nitrogen** travels in plants as inorganic ions NO_2 and NO_3 but much of the nitrogen moves in the form of amino acids and related organic compounds.
- (ii) **Sulphur and Phosphorus** small amount of these two nutrients are carried in organic forms.
- (iii) Mineral ions are frequently remobilised particularly from older senescing parts. Older dying leaves export much of their mineral content to younger leaves. Similarly, before leaf fall in deciduous plants, minerals are removed to other parts.

Elements most readily mobilised are phosphorus, sulphur, nitrogen and potassium. Some elements that are structural components like calcium are not remobilised.

Q. 2 Plants show temporary and permanent wilting. Differentiate between the two. Do any of them indicate the water status of the soil?

Ans. Wilting refers to the loss of turgidity of leaves and other soft aerial parts of a plant causing drooping, folding and rolling of non-woody plants. It occurs when rate of loss of water is higher than the rate of absorption.

| Temporary Wilting | Permanent Wilting |
|--|---|
| Temporary drooping of young leaves and shoots due to loss of turgidity especially during noon. | State of permanent loss of turgidity in leaves and other parts of plant. |
| Occurs when rate of transpiration is more than water absorption due to shrinkage of roots. | Rate of transpiration is more than rate of absorption but difference is below critical level. |
| Wilting recovers as soon as water is replenished in the soil around root hairs. | Wilting is not recovered as cells do not regain their turgidity even in presence of plentiful water and atmosphere. |
| Plant regains its normal growth. | Plant eventually dies. |



Q. 3 Which of these is a Semipermeable Membrane (SP) and which is Selectively Permeable (SL)?

- (a) Animal bladder (b) Plasmalemma (c) Tonoplast
(d) Parchment membrane (e) Egg membrane

Ans. Animal bladder Semipermeable Plasmalemma Selectively permeable
Tonoplast Selectively permeable Parchment membrane Semipermeable
Egg membrane Semipermeable

Q. 4 Halophytes may show precell pressure very much higher than atmospheric pressure. Explain how this can happen?

💡 **Thinking Process**

Halophytes have been defined as salt tolerant plants having cellular, biochemical, physiological and anatomical mechanisms allowing them to survive in high salinity conditions.

Ans. The halophytes have salt secreting glands in their epidermal tissue. The help in removal of excess salts from their internal tissue to maintain their osmolarity and the atmospheric pressure on them.

Q. 5 The radio labelled carbon in carbon dioxide supplied to potato plants in an experiment was seen in the tuber eventually. Trace the movement of the labelled carbon dioxide.

Ans. If a radio labelled carbon C^{14} is supplied to potato plants while it's carrying out photosynthesis in the presence of light, the $C^{14}O_2$ will be fixed and form radioactive products of photosynthesis, i.e., glucose $C_6^{14}H_{12}O_6$.

This radioactive glucose is converted to sucrose which would again be radioactive due to transfer of C^{14} from previous sugar molecule. These sucrose molecules then move into phloem and transported to other parts of plant.

Autoradiography technique detects the radioactive carbon (present in sugars) and traces the components and movement in the plant, i.e., through sieve tube channels of phloem from leaves (sources) to different parts (sink).

Q. 6 Water molecule is very polar. Polar end of molecule attracts opposite charges on another water molecule (acts like magnet). How will you explain this property of water with reference to upward movement of water? Comment on the upward movement of water given the intermolecular hydrogen bonding in water.

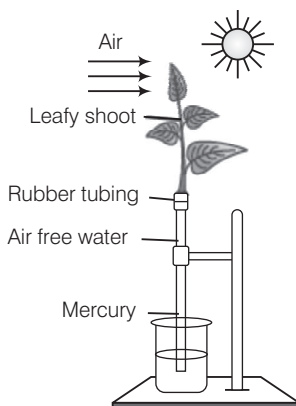
Ans. Attraction of water molecules to polar surfaces describes the adhesive properties of water. Besides, the cohesive properties include the attraction between water molecules. These two cohesive and adhesive properties contribute and help in the upward movement of water by providing.

| | |
|---------------------------|---|
| (i) High tensile strength | Capability to resist a pulling force, i.e., gravitational force. |
| (ii) High capillarity | Ability to rise in thin tubes or columns, i.e., of tracheids and vessels. |

The intermolecular hydrogen bonding in water ensures that more water molecules are attracted to each other in liquid state than in the gaseous state. This contributes to surface tension which in turn accounts for high capillarity in the xylem column.



Q. 7 Comment on the experimental setup.



- (a) What does the setup demonstrate?
- (b) What will happen to the level of water if a blower is placed close to setup?
- (c) Will the mercury level fluctuate (go up/down) if phenyl mercuric acetate is sprayed on leaves?

💡 Thinking Process

There is continuous loss of water from its body surface in the form of water. Maximum amount of water plants absorb gets lost to environment in this form. It is said transpiration. This is a necessary evil in the plants.

Ans. (a) Transpirational pull is demonstrated by this set up.

(b) Constant air blowing will increase the rate of transpiration so, level of water will go down.

(c) The mercury level will go down, if phenyl mercuric acetate is sprayed on leaves.