

MULTIPLE CHOICE QUESTIONS

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

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

Solution:

Option (c) is the answer.

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

- a. temperature
- b. light
- c. wind speed
- d. chlorophyll content of leaves

Solution:

Option (d) is the answer.

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 the above

Solution:

Option (a) is the answer.

4. The form of sugar transported through phloem is

- a. glucose
- b. fructose
- c. sucrose
- d. ribose

Solution:

Option (c) is the answer.

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.

Solution:

Option (a) is the answer.

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 putting in soil**
- d. opening of stomata**

Solution:

Option (c) is the answer.

- 7. When a plant undergoes senescence, the nutrients may be**
- a. accumulated**
 - b. withdrawn**
 - c. translocated**
 - d. None of the above**

Solution:

Option (c) is the answer.

- 8. Water potential of pure water at standard temperature is equal to**
- a. 10**
 - b. 20**
 - c. Zero**
 - d. None of the above**

Solution:

Option (c) is the answer.

- 9. Mycorrhiza is a symbiotic association of a fungus with root system which helps in**
- A. Absorption of water**
 - B. Mineral nutrition**
 - C. Translocation**
 - D. Gaseous exchange**

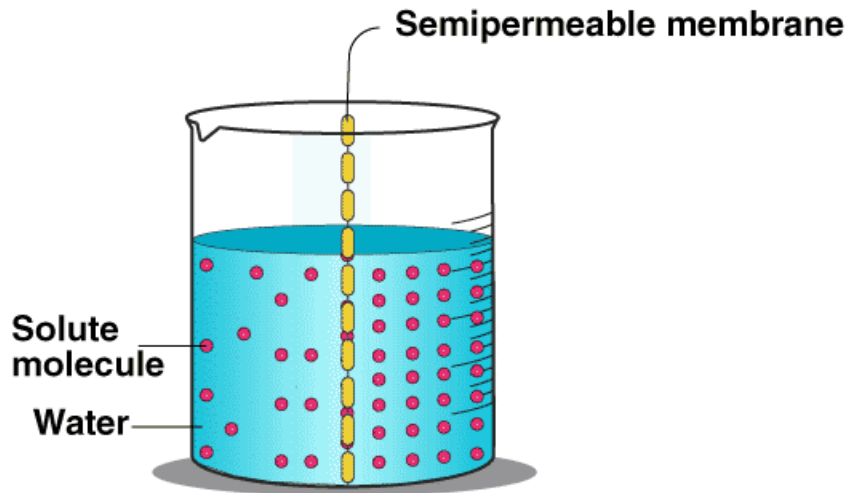
Options:

- a. Only A**
- b. Only B**
- c. both A and B**
- d. both B and C**

Solution:

Option (c) is the answer.

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



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

Solution:

Option (b) is the answer.

11. Match the followings and choose the correct option

Column I

- Leaves
- Seed
- Roots
- Aspirin
- Plasmolyzed cell

Column II

- Anti-transpirant
- Transpiration
- Negative osmotic potential
- Imbibition
- Absorption

Options:

- A-ii, B-iv, C-v, D-i E-iii
- A-iii, B-ii, C-iv, D-i E-v
- A-i, B-ii, C-iii, D-iv E-v
- A-v, B-iv, C-iii, D-ii E-i

Solution:

Option (a) is the answer.

12. Mark the mismatched pair

- Amyloplast :
- Elaioplast :
- Chloroplasts :

- store protein granule
- store oils or fats
- contain chlorophyll pigments.

d. Chromoplasts :
e. Leucoplast

contain coloured pigments
other than chlorophyll
contains colourless pigments

Solution:

Option (a) is the answer.

VERY SHORT ANSWER TYPE QUESTIONS

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

Solution:

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

2. In passive transport across a membrane, when two different molecules move in the opposite direction and independent of each other, it is called _____.

Solution:

Antiport

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 _____.

Solution:

Pressure and concentration gradient

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

Solution:

Exosmosis

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

Solution:

Pressure

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

Solution:

Transpiration pull

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 _____.

Solution:

The cell wall is freely permeable to water and substances in solutions but the membrane is selectively permeable.

8. The C₄ plants are twice as efficient as C₃ plants in terms of fixing CO₂ but lose only _____ as much water as C₃ plants for the same amount of CO₂ fixed.

Solution:

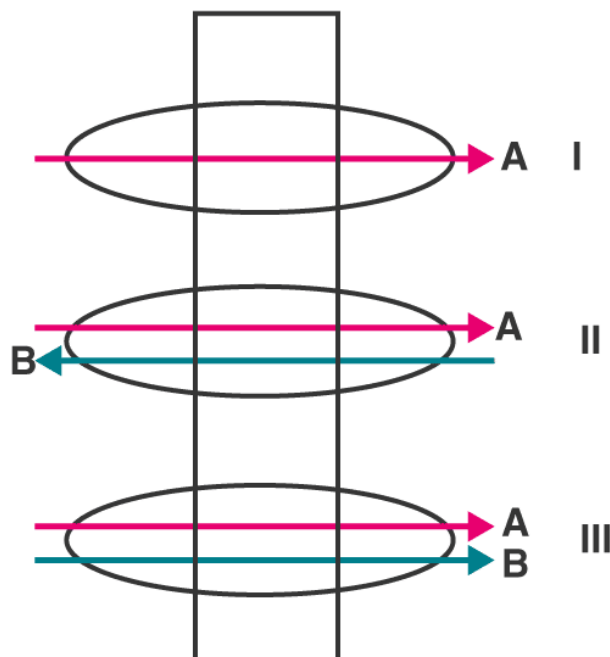
Half.

9. In a plant, translocation in the xylem is unidirectional while in phloem it is bidirectional. Explain.

Solution:

The vascular bundle, phloem is responsible for conducting the food from the source to the sink. But the process is reversed during seasons like spring because during that term the food which is stored in the sink is then supplied to the growing parts of the plant. The source and sink relation are hence variable so the direction of movement of food via the phloem can be either upwards or downwards i.e. bidirectional.

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



Solution:

- I) Uniport
- II) Antiport
- III) Symport

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

Property	Simple diffusion	Facilitated transport	Active Transport
i. Highly selective	A	Yes	F
ii Uphill transport	B	D	Yes
iii Requires ATP	C	E	G

Solution:

A B C D E = No

F and G = Yes

12. Define water potential and solute potential.

Solution:

Water potential (Ψ_w) is the sum of solute potential (Ψ_s) and pressure potential (Ψ_p): $\Psi_w = \Psi_s + \Psi_p$.

The solute potential is also known as osmotic potential is the potential of solution that allows the water to enter the solution by diffusion or osmosis due to the presence of the solute in it.

13. Why is solute potential always negative? Explain $\Psi_w = \Psi_s + \Psi_p$

Solution:

So when a solute is dissolved in water, the water potential of pure water decreases or starts assuming a negative value.

14. Tradescantia leaf epidermal peel was taken and

a. Placed in the 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?

Solution:

a. The cells would have shrunk when seen under the microscope because the salt solution is hypertonic causing water to move out of the cell thus leading to exosmosis.

b. After that when it was placed in distilled water, the cell regains its turgidity as it absorbs water and deplasmolysis occurs.

15. Differentiate between Apoplast and Symplast pathways of water movement. Which of these would need active transport?

Solution:

1. Apoplast consists of non-living parts of the plant whereas symplast consists of living parts of the plant.

2. Water diffusion in apoplast occurs by passive diffusion whereas in symplast occurs by osmosis

3. Resistance is less to water movement in apoplast whereas in symplast resistance is more to water movement.

Symplast pathway of water movement requires active transport.

16. How does water moves within the root?

Solution:

Water moves from the soil to the roots via the process of osmosis. The water potential in the soil is more than in the cytoplasm of the root hair. So water passes across the semi-permeable membrane of the root hair cell into the root via osmosis.

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

Solution:

Casparian strips are situated in the endodermal cell walls (radial and transverse) of plant roots. It prevents movement of water from pericycle to cortex thus promoting and establishing a positive hydrostatic pressure

18. Differentiate between guttation and transpiration.

Solution:

Transpiration is the loss of water from the plant by aerial parts of the plant in the form of water vapour whereas guttation is the loss of water from margins of leaves in the form of water droplets.

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

Solution:

Transpiration is the process by which plants lose water in the form of water vapour from aerial parts of the plant. When there is a huge amount of transpiration that takes place, it leads to a huge amount of water loss thus causing wilting of the plant.

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

Solution:

- i) Adhesion is the attraction between water molecules and other molecules
- ii) Cohesion is the force due to which molecules of water stay linked together due to hydrogen bonding in between them.
- iii) Surface tension is the property of the surface of a liquid to resist an external force applied owing to the cohesive nature of the molecules of the liquid. Capillary action is a result of adhesion and cohesion.

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?

Solution:

The rate of transpiration is more due to the higher temperature than the absorption of water so this will lead to wilting or losing the plant's turgidity.

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

Solution:

The type of molecular movement which is highly selective and requires special membrane proteins but does not require energy is passive diffusion.

23. Correct the statements

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

Solution:

- a) Cells shrink in a hypertonic solution and swell in hypotonic solutions.
- b) Imbibition is a special type of diffusion when water is absorbed by dead or living cells.
- c) Most of the water flow in roots occurs via the apoplast pathway.

SHORT ANSWER TYPE QUESTIONS

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?

Solution:

Minerals are taken by the roots from the soil and are transported to various parts of the plants wherever needed via the xylem vessels. The mineral requirement is not the same for all plants and neither for all plant parts so all the parts of the plants do not get the same amount of minerals.

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?

Solution:

Exudates' analysis would help to find minerals and in the form that they are mobilised in the plant because exudates are often plant sap which contains xylem sap as well as phloem sap.

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

Solution:

Using a plant growth hormone called cytokinins that help delay senescence or ageing of plant parts. Placing the cut stem immersed in water in the vase to not allow water cavitation to occur by air.

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

Solution;

The rate of transpiration also depends on internal factors like the morphological characteristics of a plant. For eg: Leaf area, the thickness of cuticle.

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

- a) Water is a polar solvent due to which it is regarded as the 'universal solvent'.
- b) Water has a high specific heat capacity.
- c) Water has low viscosity and high surface tension.
- d) The density of water decreases below 4°C.
- e) Capillarity of water

Solution:

- a) All the essential substances in living organisms are solutes dissolved in water and transported from one place to another.
- b) Specific heat is the amount of heat required to increase the temperature of one gram of matter by one degree rise in temperature
- c) Surface tension is the cohesion of the water molecules on the fluid surface of occupying the least

volume. Viscosity is the resistance of a fluid to flowing water.

d) Water expands when its temperature becomes lesser than 4°C . This decreases its density and making ice float.

e) Water rises in capillary tubes which is a property that helps transport of water from roots of the plants to other parts of the plant.

6. How are the intracellular levels of ions maintained higher than extracellular levels in animal cells?

Solution:

Animal cells have ATP powered pumps like the Na^{+} - K^{+} pump where 3Na^{+} is sent out in exchange of 2 K^{+} ions thus increasing the level of K^{+} ions in the intracellular region. This is how via the pumps, ion concentration is maintained higher intracellularly than in the extracellular region.

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

Solution:

Beetroot loses colour only when it is placed in hot water as the plasma membrane of the cells denatures at high temperature

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

Solution:

In a girdled plant, when water is supplied to the leaves above the girdle, leaves may remain green for some time because leaves have the capability of synthesizing their food by photosynthesis using water and CO_2 from the air.

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

Solution:

Plants also require mineral nutrients and charged ions like potassium, sodium, etc. which cannot be transported via simple diffusion because the cell membrane which is selectively permeable does not allow large, polar and charged particles through.

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

Solution:

Plants usually shrink when the rate of transpiration exceeds the rate of absorption of water by roots. So if we use anti-transpirants like Absciscic acid then it checks the rate of transpiration.

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

Explain.

Solution:

No. it is not possible because these are responsible for the same. The continuous water column in the xylem vessels for the sap ascent is maintained by the adhesive and the cohesive forces of water. Absence of which would have led to cavitation of xylem vessels or breakage of the water column or the sap movement upwards.

12. Keep some freshly cut flowers in a solution of food colour. Wait for some time for the dye 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?

Solution:

This experiment can demonstrate which tissue is conducting water up the stem. Coloured strands are indicative that the food colour has been conducted upwards through a conducting vessel which is the xylem.

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?

Solution:

a. This phenomenon is called exosmosis

b. If the filament is replaced in distilled water, then the protoplasm again becomes turgid as water flows in as the shrunken protoplasm swells up or gets deplasmolysed.

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

Solution:

The dissolution or diffusion of the solid crystal of sugar does not occur since the number of striking water molecules is less when water is ice cold.

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

Solution:

The salt solution being hypertonic causes exo-osmosis in plants. 1 cup salt in 2 cups of water, fairly well dissolved when sprayed on weed plants, start killing them.

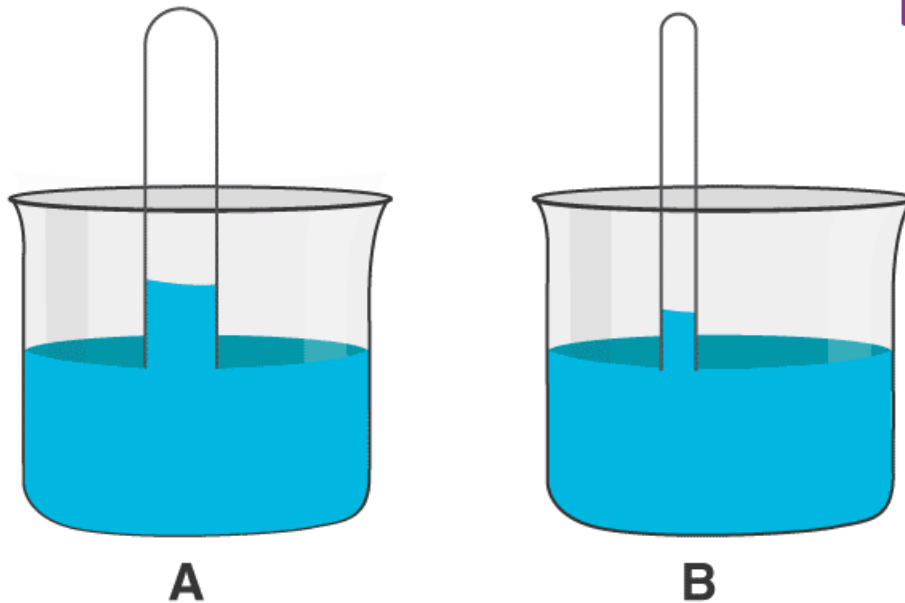
16. What is the chemical composition of xylem and phloem sap?

Solution:

Xylem sap: Water and concentration of minerals in dilute form. It is mildly acidic.

Phloem sap: traces of minerals, water, sucrose and amino acids In some species, it also transports fructose or raffinose etc

17. Observe the figure and answer the question provided below the figure.



Why does tube B show higher water rise than A?

Solution:

Tube B shows higher water rise than tube A because the surface area is less in the narrow tube or tube B due to which the surface tension is more in that so the level of rising of water is more in that as well.

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

Solution:

Aquaporins are a kind of membrane proteins that form channels in the membrane and are usually facilitating the transport of water between cells. Presence of aquaporins would increase the rate of osmosis thus facilitating it.

19. ABA (Abscisic acid) is called a stress hormone.

a. How does this hormone overcome stress conditions?

b. From where does this hormone gets released in leaves?

Solution:

a) Abscisic acid is a stress hormone and during stress conditions, it induces changes like the closing of stomata to prevent further water loss during the scarcity of water, aids in seed germination when conditions are favourable and dormancy when not and other changes as and when required.

b) This hormone, abscisic acid gets released in the leaves from the mesophyll cells of the plant.

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

Solution:

There is a deprivation of oxygen in the plant roots causing an anaerobic condition. Thus aeration is affected.

21. Differentiate between diffusion and translocation in plants.

Solution:

Diffusion is the movement of substances from a region of their higher concentration to a region of their lower concentration

Translocation is the bulk transport of material in solution inside plant channels.

22. How is facilitated diffusion different from diffusion?

Solution:

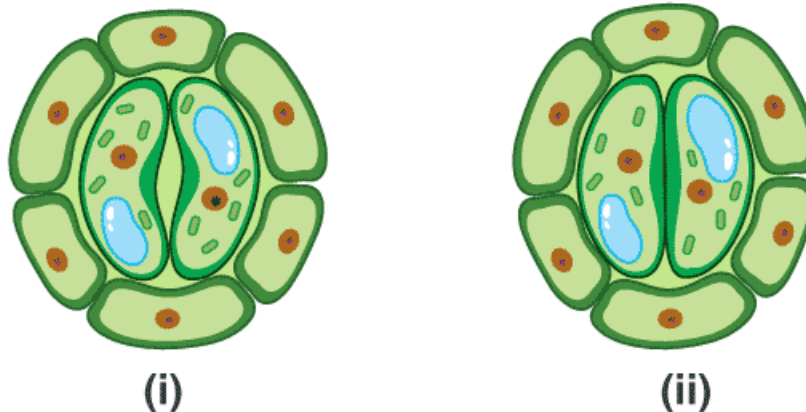
Diffusion occurs through phospholipid layer and facilitated diffusion occurs through membrane proteins

23. Explain the mass flow hypothesis of transport in phloem

Solution:

In 1930, Munch proposed the mass flow hypothesis which explains the movement of sap through the phloem. When there is a high concentration of sugar present in the source (which is where the food is prepared) then a diffusion gradient gets created between the sugar source and the sugar sink where the sugar is stored. This is responsible for drawing water into the cells from the neighbouring xylem. When this happens, turgor pressure gets created (bidirectional movement)

24. Observe the diagram and answer the following;



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

Solution:

- These types of guard cells are found in dicots because as we know the shape is bean-shaped. Whereas for monocots, it is usually dumb-bell-shaped.
- Higher water content is shown in figure (i)
- The element that plays an important role in the opening and closing of stomata is potassium ion.

25. Define Uniport, Symport and Antiport. Do they require energy?

Solution:

1. Uniport: When a single substance moves in a single direction across a cell membrane, it is called uniport.

2. Antiport: When two substances move in the opposite direction across a cell membrane, it is called antiport.
3. Symport: When two substances move in the same direction across a cell membrane, it is called symport
They do not need energy directly.

LONG ANSWER TYPE QUESTIONS.

1. Minerals are present in the soil in sufficient amounts. Do plants need to adjust the types 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?

Solution:

Yes, plants need to adjust the type and quantity of solutes that reach the xylem. The transport proteins of end dermal cell help in maintaining and adjusting solute movement. 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.

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

Solution:

In temporary wilting, plants lose turgidity when the rate of transpiration is more than the rate of water absorption from the soil but in permanent wilting, wilting of the plant occurs and is a permanent phenomenon as the soil is unable to meet the water requirement of the plant.

3. Why are natural membranes selectively permeable. Give examples.

Solution:

Natural membranes like the cell membrane are selectively permeable, which means that it allows only certain molecules to get in or go out of the cell. Example of a cell membrane is where it allows only non-polar and small molecules through the lipid bilayer along the concentration gradient.

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

Solution:

Due to the higher concentration of salt, their cell cytoplasm is hypertonic causing water from the surrounding cells or region to enter the cell cytoplasm. The pressure exerted by the cell will be higher. Salt secreting glands will be present for controlling this pressure that removes excess of salts.

5. The radiolabelled 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.

Solution:

When the potato plant carries out photosynthesis using the CO₂ which is radiolabelled, it forms Oxygen and glucose (C₆H₁₂O₆) where the carbon in the glucose molecule has the radiolabelled carbon present. The process of measuring is by autoradiography which detects the radioactive carbon and traces the components along with the movement in the plant body.

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

Solution:

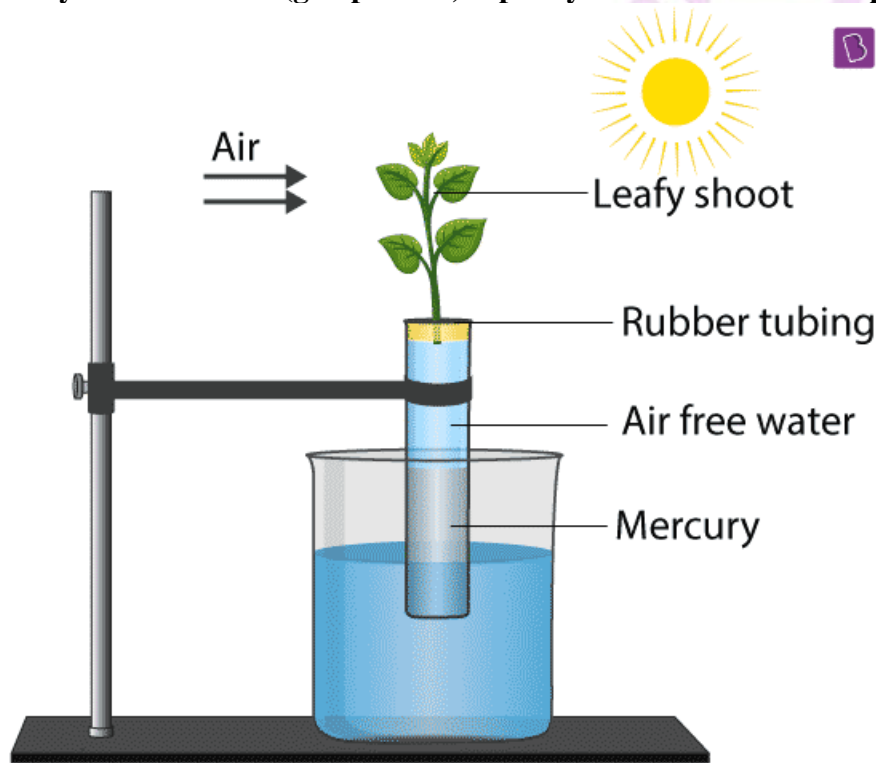
The process by which water molecules remain attached to one another via hydrogen bonding in between them is known as the cohesion of the water molecules. The upward movement of the water through xylem vessels leaves a transpiration pull which does not break due to adhesion. Tensile strength is provided by cohesion which pulls water from the root to tips.

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 phenylmercuric acetate is sprayed on leaves?



Solution:

a) The setup demonstrates the process of transpiration pull which is the force when water pulls upwards from root to leaves.

b) If a blower is placed close to the setup it will provide a wind speed due to which the rate of transpiration will increase this the level of water will rise even upwards as the transpiration pull will be more.

c) Phenyl mercuric acetate is an anti-transpirant. If it is sprayed on leaves, transpirational loss of water will stop and mercury levels will remain stable.

