TRULY AMAZING BIO CLASS IN EM

Sampath Biology

Biology

ENGLISH MEDIUM

SAMPATH LANKADHEERA

B.Sc. (Hons), M.Sc.

sampath lankadheera

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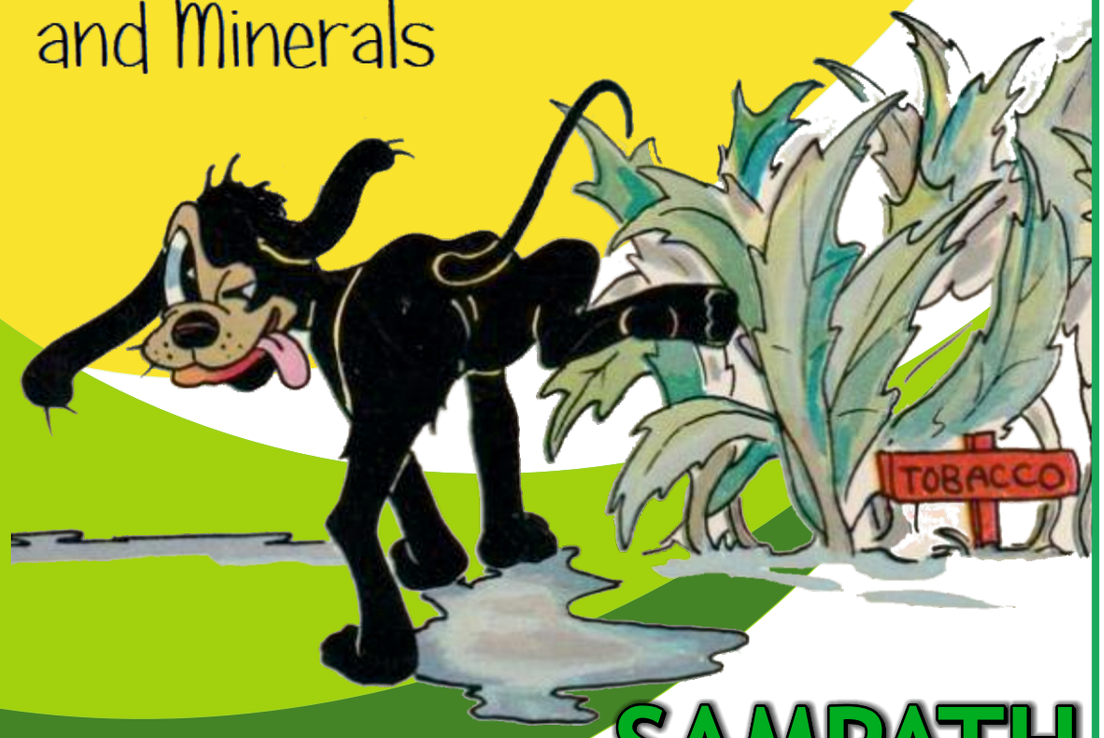
How Plants take water and Minerals



SAMPATH LANKADHEERA

B.Sc. (Hons), M.Sc.

UNIT 04

Water potential

4.2.3: Investigates the concepts of acquisition of water and minerals

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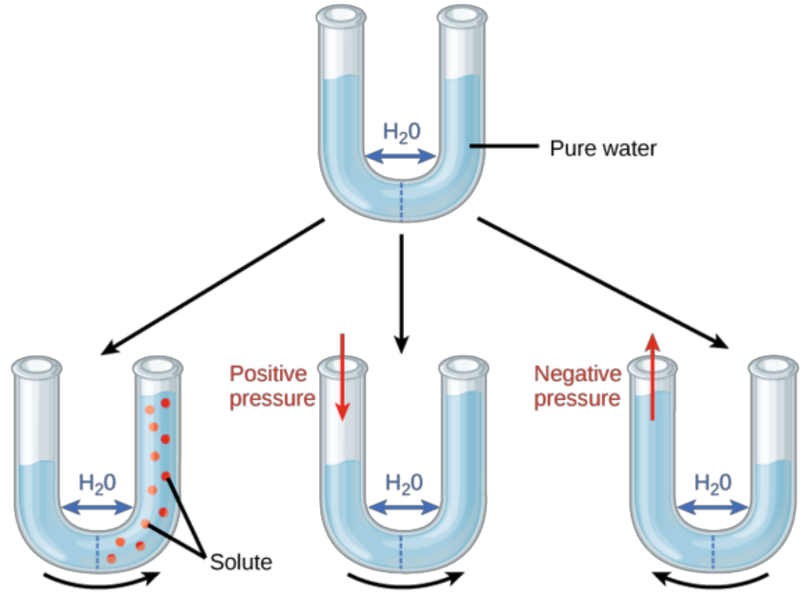
1. Describe methods of water and solutes movement in plants.

1. Both active and passive transport mechanisms occur in plants
2. Movement of some materials across membranes takes place using ATP
3. and that process is called an active transport.
4. Passive transport occurs spontaneously, and it does not require metabolic energy (ATP).
5. Passive transport includes,
6. Diffusion
7. Osmosis
8. Imbibitions
9. Facilitated diffusion
10. Bulk flow- long distance
11. Diffusion: Molecules have an energy called thermal energy, due to their constant motion.
12. One result of this motion is diffusion.
13. In the absence of other forces,
14. the movement of molecules of a substance from a place where it is more concentrated
15. to place where it is less concentrated,
16. due to random motion of molecules is called diffusion.
17. The motion of a molecule is random, but movement of a population of molecules by diffusion is directional.
18. Therefore, diffusion takes place according to a concentration gradient,
19. spontaneously
20. and not using metabolic energy (ATP).
21. Diffusion takes place across the membrane also, if the membrane is permeable to those molecules.
22. e.g. Water and soluble materials can diffuse through the cellulose cell wall
23. O_2 and CO_2 can diffuse through the plasma membrane
24. Osmosis : is a special type of diffusion.
25. The diffusion of free water molecules across a selectively permeable membrane.
26. Free water is water molecules that are not bound to solutes or surfaces.
27. Imbibition : The physical adsorption of water molecules by hydrophilic materials is called imbibition.
28. e.g. adsorption of water molecules by the cellulose cell walls.
29. Facilitated diffusion: Movement of water
30. and hydrophilic solutes across the membranes passively
31. with the help of transport protein that span the membrane is called facilitated diffusion.
32. Transport proteins are very specific.
33. They transport some substances but not the others.
34. This movement also takes place along concentration gradient and it is a passive movement.
35. Bulk flow: is the movement of liquid and the materials (entire solution) in response to pressure gradient.
36. Always the bulk flow transports materials from higher pressure to lower pressure region.
37. It is a long-distance transport method.
38. This flow does not occur through the membranes
39. and occurs at much greater speed than diffusion.
40. This method of transport is independent of solute concentration gradient.

Calculations

1. Briefly describe how following events change water potential.



(i) adding solutes to the right side affects water potential.

.....

(ii) Applying positive pressure left side.

.....

(iii) Applying negative pressure to the left side.

.....

Pattern 1

2. Water potential equation is $\psi^{cell} = \psi_s^{cell} + \psi_p^{cell}$. If a cell has following values for ψ_s^{cell} = -1660 KPa, ψ_p^{cell} = 300KPa, Then calculate ψ^{cell} .

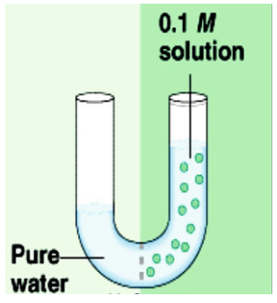
3. Ψ of a cell is -1.33 MPa. Solute potential of the cell is –1.66 MPa. Find the Ψp of the cell.
   Remember ψ_p^{cell} of a living cell is always (+). Never becomes (-)

Pattern 2

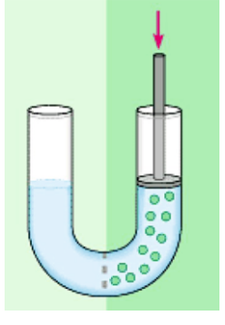
4. Take a glass of water and dissolve salt. $\psi^{sol} = \psi_s^{sol} + \psi_p^{sol}$. For solutions always $\psi_p^{sol} = 0$
   Therefore, $\psi^{sol} = \psi_s^{sol}$. You are given a solution with 0.3M concentration. If 0.1M solution has – 0.23Mpa water potential then calculate water potential of 0.3M solution.

5. You are given a solution with 0.1M concentration. ψ_s = – 0.23Mpa. Calculate ψ_s of 0.15M, 0.20M, 0.25M, 0.30M Solutions.

6. Water potential equation is $\psi = \psi_s + \psi_p$. If a 0.1M solution has following values for ψ_s^{cell} = -230 KPa, Then calculate ψ solution. 0.1M concentration. ψ_s = – 0.23Mpa.



7. What is the water potential of the solution of following system with 0.1M solution, when physical pressure increase to ψ_p = 0.23 of the solution. What is the direction of water flow. 0.1M concentration. ψ_s = – 0.23Mpa.



Model question

1. Describe methods of water and solutes movement in plants.

(ii) Why Ψp is 0 at point A.

.....

(iii) Calculate the water potential of the cell at fully turgid stage.

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.....

(iv) What is the water potential of the cell at point A.

.....

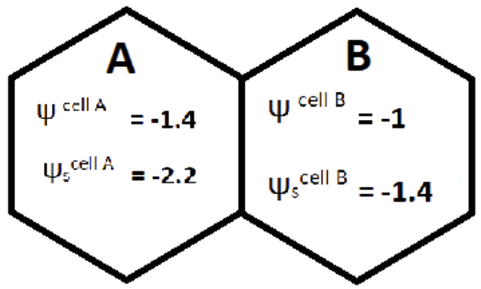
.....

(v) Draw the change of water potential in the graph.

MCQ

1. Which of the following units are used to measure water potential?
   (1) Atm (2) Bar (3) MPa (4) Nm^{-2} (5) Pa

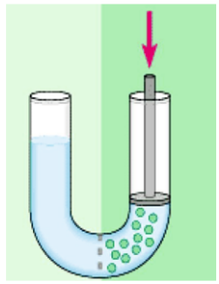
2. A and B are two plant cells adjacent to each other. The Ψ_W and Ψ_S values of the two cells are indicated in the diagram. Which one of the following statements is incorrect?
   (1) Water will move from cell B to cell A. (2) Movement of water will occur until ΨW of the cells are equal.
   (3) ΨP of cell A is 1.0 MPa. (4) ΨP of cell B is 0.6 MPa.
   (5) The ΨW and ΨS values of normal plant cells are always negative. (2011)



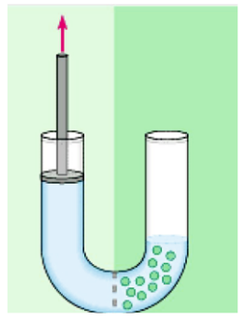
3. Which of the following is most likely to occur if a plant cell with a solute potential of - 0.3 MPa and a pressure potential of 0.2 MPa is placed in pure water?
   (1) Water will move out of the cell. (2) Water will move into the cell.
   (3) Solutes will move out of the cell.
   (4) There will be no net movement of water either into or out of the cell.
   (5) Water may move into or out of the cell depending on the direction of the water potential gradient.
   (2015/34)

4. Part of the leaf epidermal cells were immersed in distilled water for 30 minutes. All cells became turgid and reach to equilibrium. Which of the following statement is correct regarding these cells?
   (1) The water potential and the osmotic potential of the cell sap is having equal opposite values.
   (2) The water potential of the cell sap and the pressure potential are having equal values.

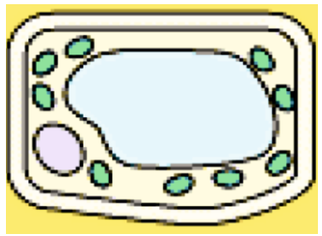
8. What is the water potential of the solution of below system with 0.1M solution, when physical pressure increase to $\psi_p = 0.30$ of the solution. What is the direction of water flow. 0.1M concentration. $\psi_s = -0.23$Mpa.



9. What is the water potential of the solution of below system with 0.1M solution when physical pressure decrease to $\psi_p = -0.30$ of pure water. What is the direction of water flow. 0.1M concentration. $\psi_s = -0.23$Mpa.

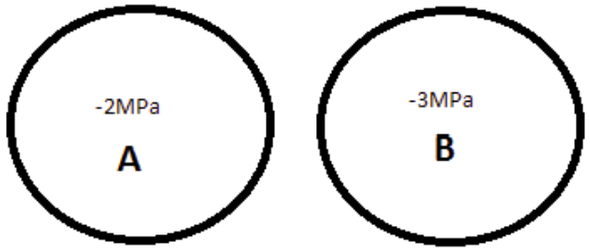


10. ψ of a cell is -1.50MPa. Solute potential (ψ_s) of the cell is –1.75 MPa. Find the ψ^p of the cell.



Pattern 3

11. Two nearby plant cells present and you are asked to calculate water potential at equilibrium, then **Calculate** $\psi^{cell\ A}$ and $\psi^{cell\ B}$, get average = $(\psi^{cell\ A} + \psi^{cell\ B})/2$
    Remember exchange of water between 2 cells will not change ψ_s^{cell} of cells. But will change ψ_p^{cell} of cells.
    Following diagram shows water potential values of near by cells.



(i) What is the direction of flow of water.

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(ii) What is the water potential of cell after reaching to the equilibrium.

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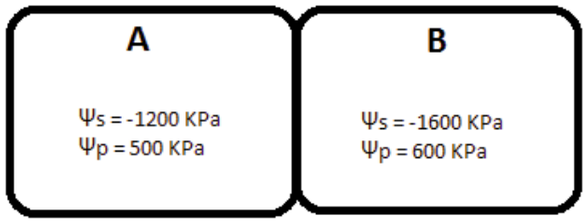
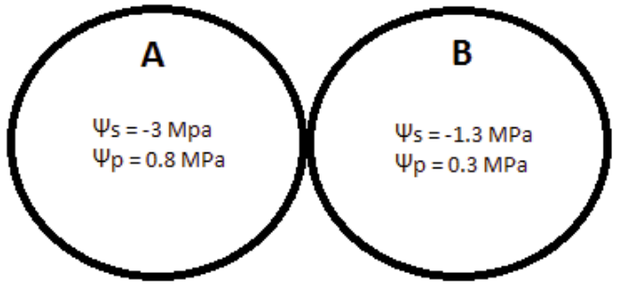
12. Calculate the water potential of cells after reach to an equilibrium.



13. Following diagram shows two adjoining turgid plant cells.



(ii) What is the pressure potential of the cell at equilibrium.

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25. A cell with Ψs –1.0 MPa, ΨP 0.3MPa is immersed in a solution with Ψ – 4.0MPa .

(i) What is the direction of flow of water.

.....

(ii) Describe the solution with respect to the cell.

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26. Water potential of a cell is –1.2MPa. When this cell is immersed in a solution of with solute potential -1.8MPa solution. Calculate the ΨP.

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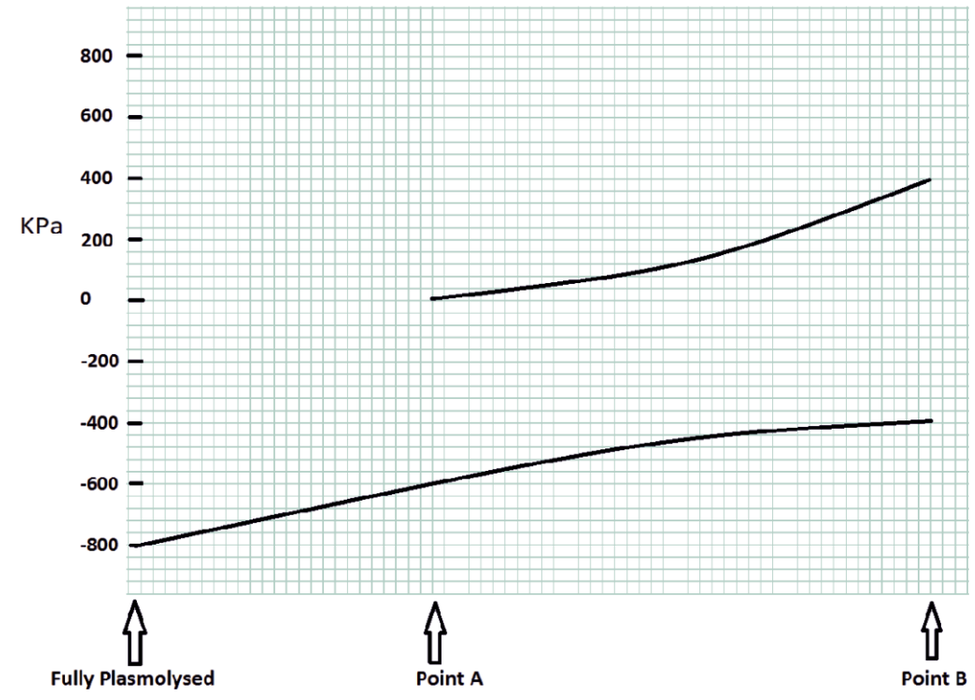
27. Graph shows the change of Ψs and Ψp of a plasmolysed cell when immersed in pure water.



(i) What is the term can be used for point A.

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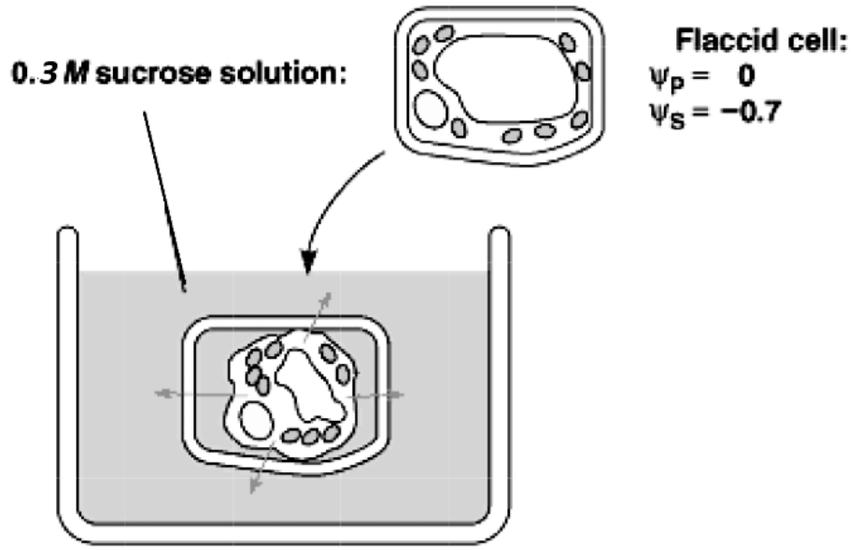
23. *Given flaccid plant cell immersed in 0.4 M solution.*



(i) Calculate the water potential of the cell at equilibrium.

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(iii) Calculate the pressure potential of the cell at equilibrium.

.....

.....

(iv) Calculate the solute potential of the cell at equilibrium

.....

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24. A cell with ψ_s –1.0 MPa, ψ_p 0.3MPa is immersed in a solution with Ψ – 4.0MPa .

(i) What is the water potential of the cell at equilibrium.

.....

.....

(ii) What is the solute potential of the cell at equilibrium.

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.....

(i) What is the direction of flow of water.

.....

(ii) What is the water potential of cell after reaching to the equilibrium.

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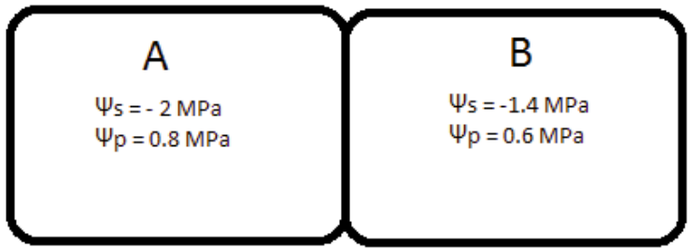
14. **When cells at equilibrium, we assume that solute potential of cells remain unchanged. But pressure potential changes.** Following diagram shows two turgid plant cells.



(i) What is the direction of flow of water.

.....

(ii) What is the water potential of cell after reaching to the equilibrium.

.....

(iii) What is the solute potential of A and B cell at equilibrium.

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(iv) What is the pressure potential of cell A at the equilibrium.

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(v) What is the pressure potential of cell B at the equilibrium

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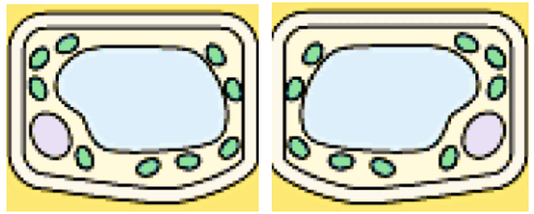
15. Following diagram shows water potential values of 2 near by cells.



ψ_s^A = -1350 ψ_s^B = -1650

ψ_p^A = 350 ψ_p^B = 350

(i) What is the direction of flow of water.

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(ii) What is the water potential of cell after reaching to the equilibrium.

.....

(iii) What are solute potential values at equilibrium

.....

(iv) What are pressure potential values at equilibrium.

.....

16. Following table shows solute potential and pressure potential of 3 cells.

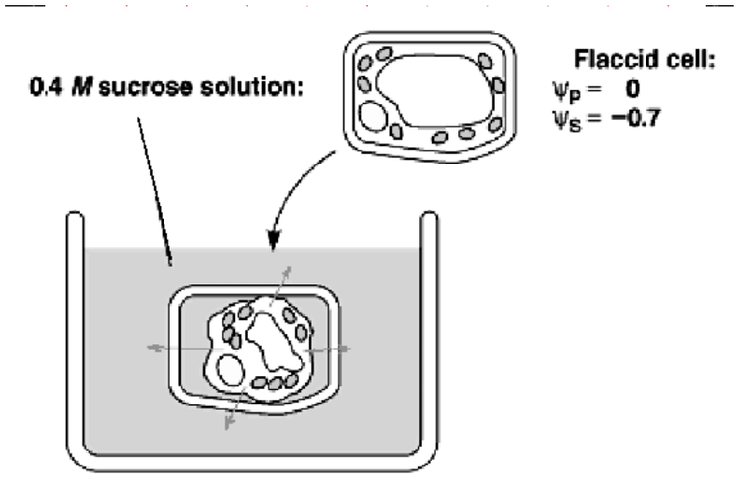
Cell	Pressure potential (KPa)	Solute potential (KPa)
A	200	-900
B	500	-1000
C	500	-600

(i) Calculate the water potential of above cells.

.....

.....

21. Given flaccid plant cell immersed in 0.4 M solution.



(i) Calculate the water potential of the cell at equilibrium.

.....

.....

(iii) Calculate the pressure potential of the cell at equilibrium.

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.....

(iv) Calculate the solute potential of the cell at equilibrium

.....

.....

22. A cell at incipient plasmolysis with Ψs –2.0 Mpa plant cell with a vacuole is immersed in a solution of Ψ= 1M concentration .

(i) Calculate Ψ and Ψp of the cell at equlibrium.

.....

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(ii) What is the nature of the solution.

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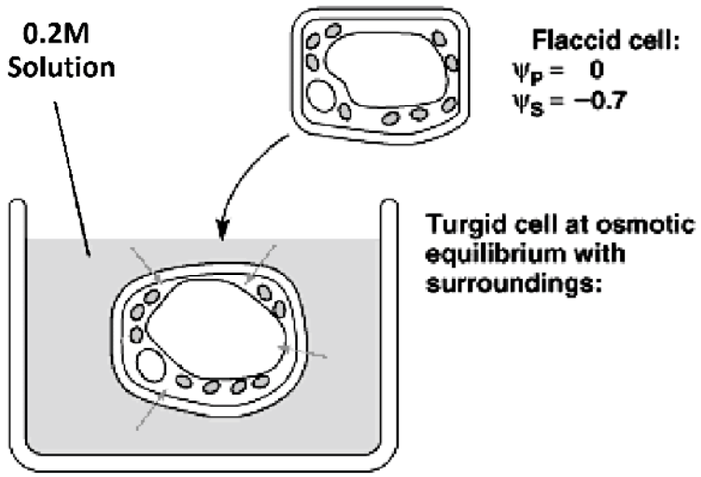

(i) Calculate the water potential of the cell at equilibrium.

.....

.....

(ii) Calculate the pressure potential of the cell at equilibrium

.....

.....

(iii) What can you say about the pressure potential of this cell compared to the cell immersed in pure water

.....

.....

20. A cell at incipient plasmolysis with Ψs –2.0 Mpa plant cell with a vacuole is immersed in a solution of Ψ= –1.2 MPa .

(i) Calculate Ψ and Ψp of the cell at equlibrium.

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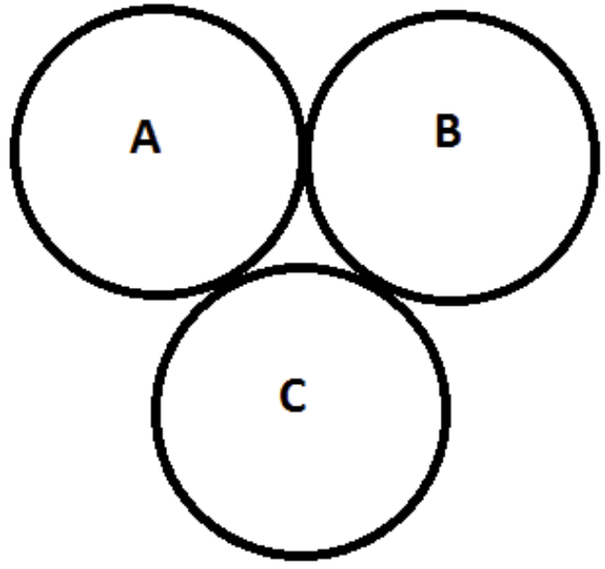

(ii) Show the direction of flow of water in those cells.

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(iii) Calculate the water potential of cells at equilibrium.

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(iv) What is the pressure potential of cells at equilibrium

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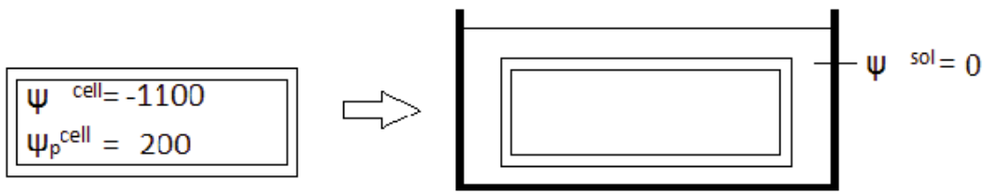
Pattern 4

17. **When a plant cell is immersed in a solution endosmosis or exo-osmosis can occur. Water potential of outer solution remains unchanged because the amount of water enter and leave the cell is negligible to make any change in outer solution. At equilibrium cell reaches to water potential of outer solution. Cell solute potential change but we assume it remain unchanged. Cell pressure potential change.**

(i) If following cell is immersed in the given solution. Calculate solute potential of the cell.

(ii) Immerse this cell in pure water and allowed to reach equilibrium. Calculate the water potential at equilibrium.



(ii) Calculate the pressure potential of the cell at equilibrium

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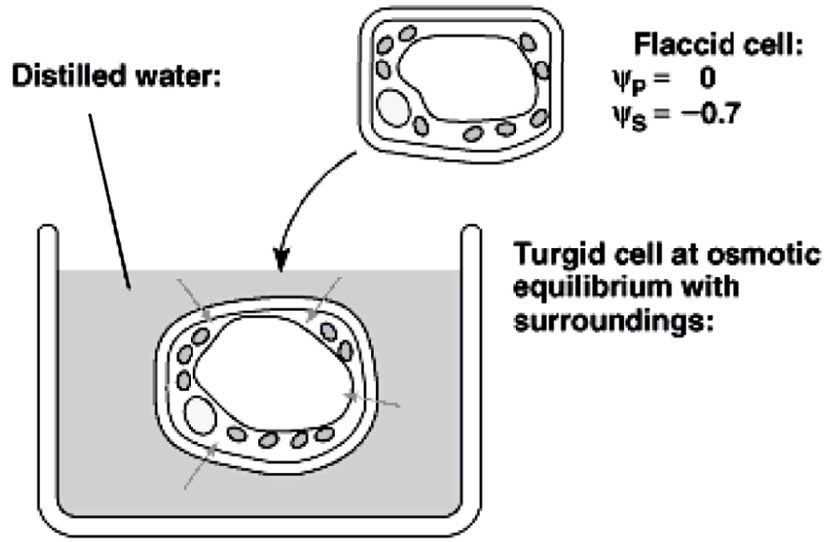
18. Given flaccid plant cell immersed in distilled water.



(i) Calculate water potential of the cell before immersed in distilled water.

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(ii) Calculate the water potential of the cell at equilibrium.

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(iii) What is the change of water potential of the pure water at equilibrium.

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(iv) Calculate the pressure potential of the cell at equilibrium

.....

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19. Given flaccid plant cell immersed in 0.2 M solution.