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Water Potential and Osmosis

1. What is the symbol for water potential?

2. What is the symbol for osmotic pressure?

3. What is the equation for calculating osmotic pressure?

4. What is the symbol for pressure potential?

5. What is the symbol for solute potential (aka osmotic potential)?

6. What is the equation for calculating potential (either water potential or solute potential)?

7. What is the water potential for a solution that is 0.1M? (assume $i = 1$, and a temperature of 22°C)

8. What is the solute potential for a solution that is 0.5M? (assume $i = 1$, and a temperature of 0°C)

9. What is the highest water potential a solution can have? Explain.

10. If you are simply given Ψ_p and Ψ_s, what would be the equation for calculating water potential?

11. What is the equation for calculating the change in water potential? In other words, this equation allows you to determine which way the water will move in response to two different concentrations.

12. You have a cell with an internal solute concentration of 0.1M and you place it into a beaker containing a solution that has a concentration of 0.2M. Use the equation for osmotic potential and change in osmotic potential to show which direction the water will move, temperature is 22°C, and $i = 1$. ***Show your work.***

13. Again, you repeat the experiment as performed in Question #12, but this time you place the cell into a solution that has a concentration of 0.01M. Use the equation for osmotic potential and change in osmotic potential to show which direction the water will move, temperature is 22°C, and $i = 1$. ***Show your work.***

14. Now you have a cell with an internal solute concentration of 0.35M and you place it into a beaker containing a solution that has a concentration of 0.28M. Use the equation for osmotic potential and change in osmotic potential to show which direction the water will move, temperature is 22°C, and $i = 1$. ***Show your work.***

15. You have a U-tube which is separated by a membrane permeable only to water. To the right side of this tube, you are applying 3.25 barr of pressure with a special piston. On the right side is a solution which contains a 1M solution of sucrose, and on the left is pure water. Is this enough pressure to prevent the movement of water? The temperature of the apparatus is 22°C, and $i = 1$. ***Show your work.***

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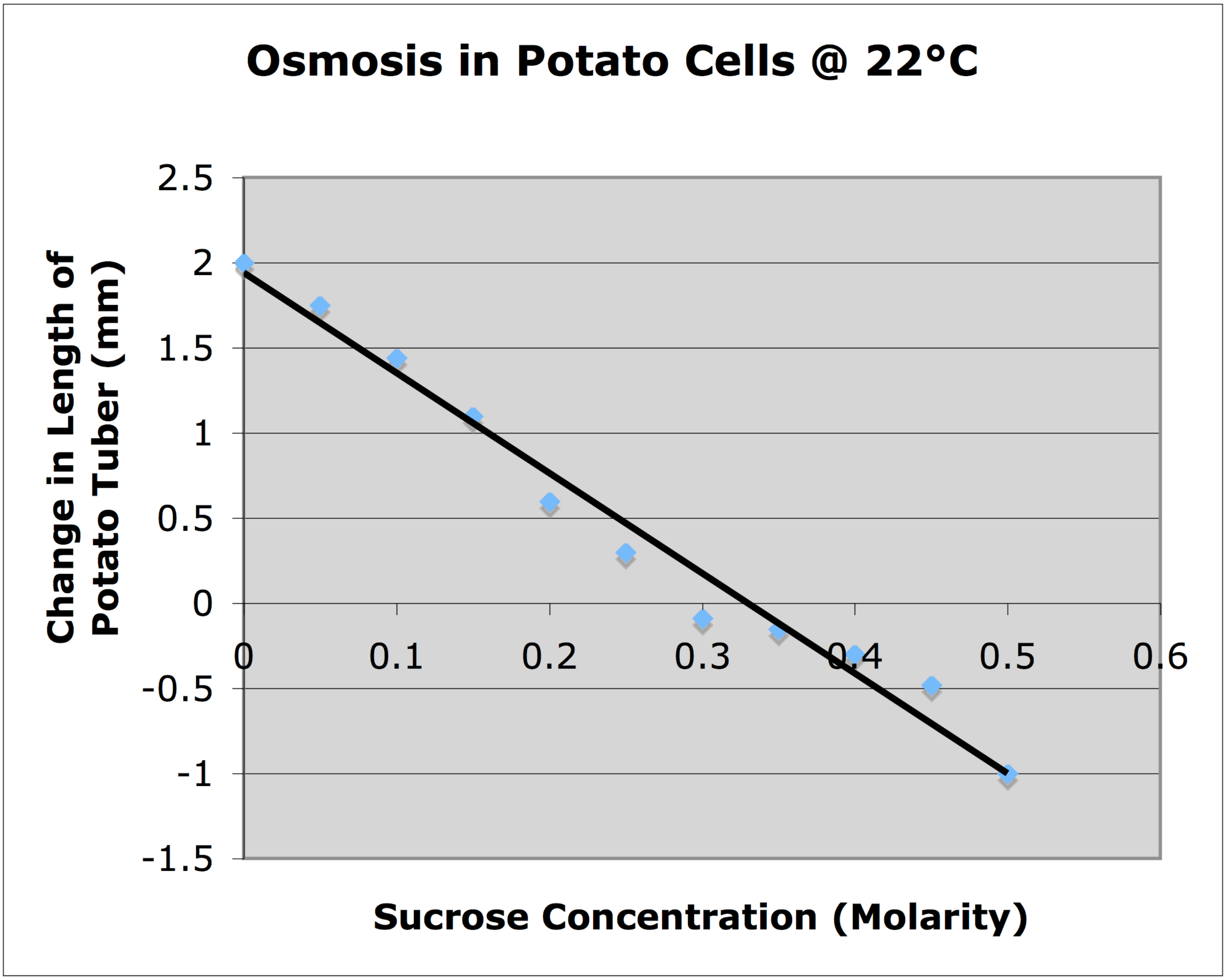

16. Based on the information in the above graph, what is the approximate molarity of the potato cell?

17. What then is the approximate solute potential of the potato cell (assume i = 1, and 22°C)? At what concentration should you place the cell in to ensure the cell doesn't burst or plasmolyze? ***Show your work.***

18. Use the diagram of the U-tube in the figure below to answer the following questions.

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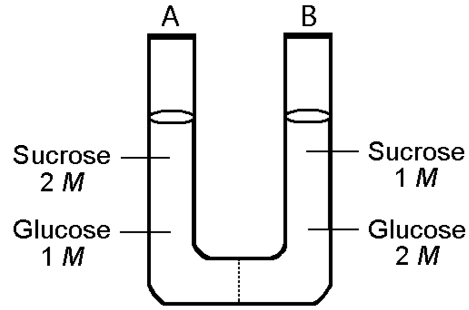


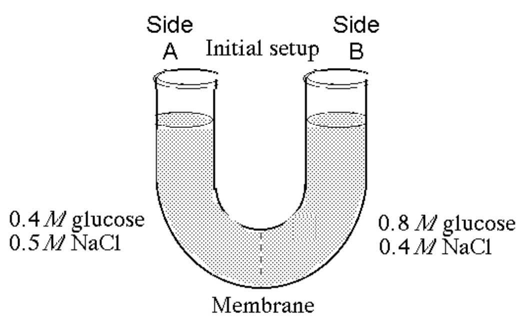
The solutions in the two arms of this U-tube are separated by a membrane that is permeable to water and glucose but not to sucrose. Side A is half filled with a solution of 2 M sucrose and 1 M glucose. Side B is half filled with 1 M sucrose and 2 M glucose. Initially, the liquid levels on both sides are equal. (i = 1 for sucrose and glucose, the temperature is 22°C)

Initially, in terms of tonicity, what can you say about the solution in side A with respect to that in side B? Show this mathematically. $\Psi_{\text{of side A}} = \Psi_{\text{glucose}} + \Psi_{\text{sucrose}}$ and $\Psi_{\text{of side B}} = \Psi_{\text{glucose}} + \Psi_{\text{sucrose}}$ Remember, $\Psi = -iMRT$

19. After the system in question #18 reaches equilibrium, what changes are observed with respect to the height of the water?

20. Use the following equations to mathematically support your answer to Question #19: $\Psi_{\text{of side A}} = \Psi_{\text{glucose}} + \Psi_{\text{sucrose}}$ and $\Psi_{\text{of side B}} = \Psi_{\text{glucose}} + \Psi_{\text{sucrose}}$ Remember, $\Psi = -iMRT$. Which way will the water move and which side will be higher? (i = 1 for sucrose and glucose, the temperature is 22°C) ***Show your work.***

21. Use the figure below to answer the following questions.



The solutions in the arms of a U-tube are separated at the bottom of the tube by a selectively permeable membrane. The membrane is permeable to sodium chloride but not to glucose. Side A is filled with a solution of 0.4 M glucose and 0.5 M sodium chloride (NaCl), and side B is filled with a solution containing 0.8 M glucose and 0.4 M sodium chloride. Initially, the volume in both arms is the same. (i = 1 for glucose, and i = 2 for NaCl, the temperature is 22°C)

If you examine side A after 3 days, what would one expect to find with regard to the concentration of NaCl and the water level?

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22. Use the following equations to mathematically support your answer to Question #21: $\Psi_{\text{of side A}} = \Psi_{\text{glucose}} + \Psi_{\text{NaCl}}$ and $\Psi_{\text{of side B}} = \Psi_{\text{glucose}} + \Psi_{\text{NaCl}}$ Remember, $\Psi = -iMRT$. Which way will the water move and which side will be higher? ***Show your work.***

Bonus Question:

23. You are asked to estimate if a certain species of plant could live in a salt marsh. You collect the following data:

    a. The overall Ψ of the soil (Ψ_{soil}): -2.5MPa (-25.0 barr)
    b. Solute concentration of plant cell contents: 0.1M (assume i=1, and 13°C)
    c. Pressure potential of the plant cells is: -1.9 MPa (-19.0 barr)

Do you think the plant could grow in this environment? Why or why not? ***Show your work.***