Water Potential

Practice Set 2

Key

Use text book to help you and show your work:

1. A solution in a beaker has sucrose dissolved in water with a solute potential of -0.5MPa. A flaccid cell is placed in the above beaker with a solute potential of -0.9MPa.

   a. What is the pressure potential of the flaccid cell before it was placed in the beaker?

   $\Psi_p = 0$; it's flaccid

   b. What is the water potential of the cell before it was placed in the beaker?

   $\Psi_{cell} = \Psi_p + \Psi_s$ $\Psi_{cell} = 0 + (-.9)$ $\boxed{\Psi_{Cell} = -0.9\ MPa}$

   c. What is the water potential in the beaker containing the sucrose?

   $\Psi_{solution} = \Psi_p + \Psi_s$ $\Psi_{sol.} = 0 + (-0.5)$ $\boxed{\Psi_{sol} = -0.5\ MPa}$

   d. How will the water move? into the cell $-.5 > -.9$

   e. What is the pressure potential of the plant cell when it is in equilibrium with the sucrose solution outside? Also, what is its final water potential when it is in equilibrium?

   $-.5 = \Psi_p + (-.9)$

   $\boxed{0.4 = \Psi_p}$

   f. Is the cell now turgid/flaccid/plasmolysed?

   turgid

   g. Is the cell hypotonic or hypertonic with respect to the outside?

   hypertonic (lower Ψ)

   h. If it is hypo/[✓ hyper] (choose one) tonic – this means that its water potential is higher/[✓ lower] (choose one) than the outside.

2. A solution in a beaker has sucrose dissolved in water with a solute potential of -0.7MPa. A flaccid cell is placed in the above beaker with a solute potential of -0.3MPa.

   a. What is the pressure potential of the flaccid cell before it was placed in the beaker?

   $\Psi_p = 0$

   b. What is the water potential of the cell before it was placed in the beaker?

   $\Psi_{cell} = \Psi_p + (-.3)$ $\boxed{\Psi_{cell} = -.3}$

   c. What is the water potential in the beaker containing the sucrose?

   $\Psi_{beaker} = \Psi_p + (-.7)$ $\boxed{\Psi_{beak} = -0.7}$

   d. How will the water move?

   out (cell → water/solution)

   e. What is the pressure potential of the plant cell when it is in equilibrium with the sucrose solution outside? Think carefully – does the plant cell wall change shape?

   No; cell wall present Ψ ~~cell~~

   $-.7 = \Psi_p + (-.3)$

   $\boxed{-.4 = \Psi_p}$

   f. Also, what is the cell's final water potential when it is in equilibrium?

   $\Psi_{Cell} = -.4 + (-.3)$ $\boxed{\Psi_{cell} = -.7}$

   g. Is the cell now turgid/flaccid/plasmolysed?

   plasmolyzed

   h. What is the cell's solute potential when it is in equilibrium?

   $-.7 = 0 + \Psi_s$ $\boxed{\Psi_s = -.7}$

   i. Is the cell hypotonic or hypertonic with respect to the outside?

   hypotonic

   j. If it is [✓ hypo]/hyper (choose one) tonic – this means that its water potential is [✓ higher]/lower (choose one) than the outside.

Water Potential

Practice Set 2

Name ______________________________

The equation for Water Potential is $\Psi = \Psi_s + \Psi_p$

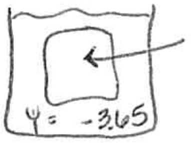
Solute Potential $\Psi_s = -iCRT$

i = ionization number = the number of particles the molecule will make in water. For NaCl, this would be 2. For sucrose, 1.
C = molar concentration
R = pressure constant = 0.0831 liter bar / mole K or 0.00831 liter MPa / mole K
T = temperature in degrees Kelvin = 273 + °C of solution

1. Calculate the water potential of a solution of 0.15M sucrose. 20° C

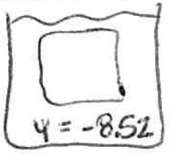
$$\Psi = \Psi_s + \Psi_p$$
$$\downarrow$$
$$-iCRT \qquad -(1)(0.15)(293)(.0831) = -3.65 + \overset{(0)}{\Psi_p} = \overset{\Psi =}{\boxed{-3.65}}$$

2. If a flaccid cell ($\Psi_p = 0$) having a solute potential of -0.65 MPa is placed in the above solution, what will be its pressure potential at equilibrium?



$$\Psi = -.65 + 0$$
$$-3.65 = -.65 + \Psi_p \qquad \boxed{\Psi_p = -3}$$

3. If the cell above is removed from that solution of 0.15M sucrose and placed in a solution of 0.35M sucrose, will the pressure potential of the cell increase or decrease? What will be the new value?



$$\Psi_s = -(1)(0.35)(.0831)(293)$$
$$= -8.52$$

decrease

$$-8.52 = -.65 + \Psi_p$$
$$\boxed{\Psi_p = -7.87}$$

4. You measure the total water potential of a cell and find it to be -0.24 MPa. If the pressure potential of the same cell is 0.46 MPa, what is the solute potential of that cell?

$$\Psi = -.24$$
$$-.24 = \Psi_s + .46 \qquad \boxed{\Psi_s = -0.7}$$

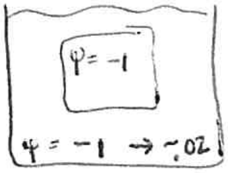
5. If a cell having a solute potential of -0.35 MPa is placed in a solution of pure water, what will be its pressure potential at equilibrium? $\Psi_s = -.35$

$$0 = -.35 + \Psi_p \qquad \boxed{\Psi_p = .35}$$

6. What is the water potential of a cell with a solute potential of -0.67 MPa and a pressure potential of 0.43 MPa?

$$\Psi = (-.67) + (.43)$$
$$\boxed{\Psi = -.24}$$

7. A cell is in equilibrium with an outside solution where **Ψoutside** = -1.0 MPa. Water is added to the outside solution such that **Ψoutside** = -0.02 MPa and the cell volume increases 1.5 times. What pressure potential is required to stop the movement of water into the cell?



$$\Psi_{in} = \Psi_{out} \qquad \Psi_{in} = \Psi_s + \Psi_p$$

@ equil,

$$-.02 = -1 + \Psi_p \qquad \boxed{\Psi_p = 0.98 \text{ MPa}}$$

8. A hypertonic environment has a high / [✓ low] (circle one) water potential compared to the cell? Why?

more solute = $-i\boxed{C}RT$ greater, ∴ a $\underline{\text{lower}}$ Ψ_s

9. Then, water will move which way according to water potential rules?

<u>Into</u> the hypertonic solution / toward lower Ψ