20 points

Calculation of Water Potential from Experimental Data

Name: ANSWER KEY **Date:** _____

Water potential values are useful because they allow us to predict the direction of the flow of water. Remember that water flows from an area of high water potential to an area of lower water potential.

Example:

The solute potential of a sucrose solution can be calculated using the following formula:

$\Psi_s = -iCRT$

- i = Ionization constant (for sucrose this is 1.0 because sucrose is a sugar and does not ionize in water.)
- C = Molar concentration
- R = Pressure constant (R = 0.0831 liter bars/mole °K)
- T = Temperature °K (273 + °C of solution)

The units of measure will cancel as shown in the following example:

If you have a 1.0 M sugar solution at 22 °C under standard atmospheric conditions

$\Psi_s = -i \times C \times R \times T$

$\Psi_s = -(1)$ (1.0 mole/liter) (R = 0.0831 liter bars/mole °K) (295 °K)

$\Psi_s = -24.51$ bars

Knowing the solute potential of the solution (Ψ_s) and knowing that the pressure potential of the solution is zero ($\Psi_p = 0$) allows you to calculate the water potential of the solution. The water potential will be equal to the solute potential of the solution.

$\Psi = 0 + \Psi_s$ or $\Psi = \Psi_s$

1. The water potential of the solution at equilibrium will be equal to the water potential of the potato cells. What is the water potential of the potato cells in the lab you completed? Show ALL of your work in the space below. Include the formula. Don't forget units. **(3 points)**

Unique to the lab
-find molarity based off graph

2. **Predict** the direction in which water will flow given the following information:

A student calculates that the water potential of a solution in a dialysis bag is equal to -6.25 bars ($\Psi_s = -6.25$, $\Psi_p = 0$). The water potential of a solution surrounding the bag is -3.25 bars ($\Psi_s = -3.25$, $\Psi_p = 0$). In which direction will water flow? **Justify** your answer. **(2 points)**

Water will flow from an area of high water potential (surrounding the bag) to an area of low water potential (inside dialysis bag).

water moves from H → L water pot.

20 points

3. If a plant cell's water potential is lower than its surrounding environment and if pressure is equal to zero, is the cell hypertonic (in terms of solute concentration) or hypotonic to its environment? Will the cell gain or lose water? **Justify** your answer. **(3 points)**

the cell would be hypertonic compared to its environment + it would gain water. ↓ water potential = more solute = more room for water

4. If yam cores were placed in a salt (NaCl) solution at 22 °C for 24 hours and the molar concentration is determined to be 0.34 M, calculate the water potential. (Ionization constant for NaCl = 2.0) Show ALL of your work in the space below. Include the formula and don't forget units. **(3 points)**

$\Psi_s = -iCRT$

$= -(2)(.34\ M)(.0831\ L\ bars/mole\ K)(295)$

$= -16.6$ bars

$\Psi = \Psi_p + \Psi_s$

$= 0 + -16.6$

$\Psi = -16.6$ bars

5. What effect does adding solute have on the solute potential component (Ψ_s) of that solution? **Justify** your answer. **(2 points)**

Adding solute lowers the solute potential bc ↑ M or C in the equation making it lower

6. If a cell's Ψ_p = 3 bars and its Ψ_s = -4.5 bars, what is the resulting Ψ? Show ALL of your work in the space below. Include the formula and don't forget units. **(2 points)**

$\Psi_p = 3$ bars $\quad \Psi = \Psi_s + \Psi_p$

$\Psi_s = -4.5$ bars $\quad = -4.5 + 3$

$= -1.5$ bars

7. At 20 °C, a cell with Ψ_p of 3 bars is in equilibrium with the surrounding 0.4M sucrose solution in an open container. What is the molar concentration of sucrose in the cell? Show ALL of your work in the space below. Include the formula and don't forget units. **(5 points)**

$\Psi_p = 3$ bars

Solution $\Psi_s = -iCRT$

$= -(1)(.04)(.0831)(293)$

$= -9.74$ bars

$\Psi_s = -9.74 - 3$ bars

$= -12.74$ bars

$-12.74 = -iCRT$

$\frac{-12.74}{-iRT} = C$

$= C$

$\frac{-12.74}{-(1)(.083)(293)}$

$= .52\ M$