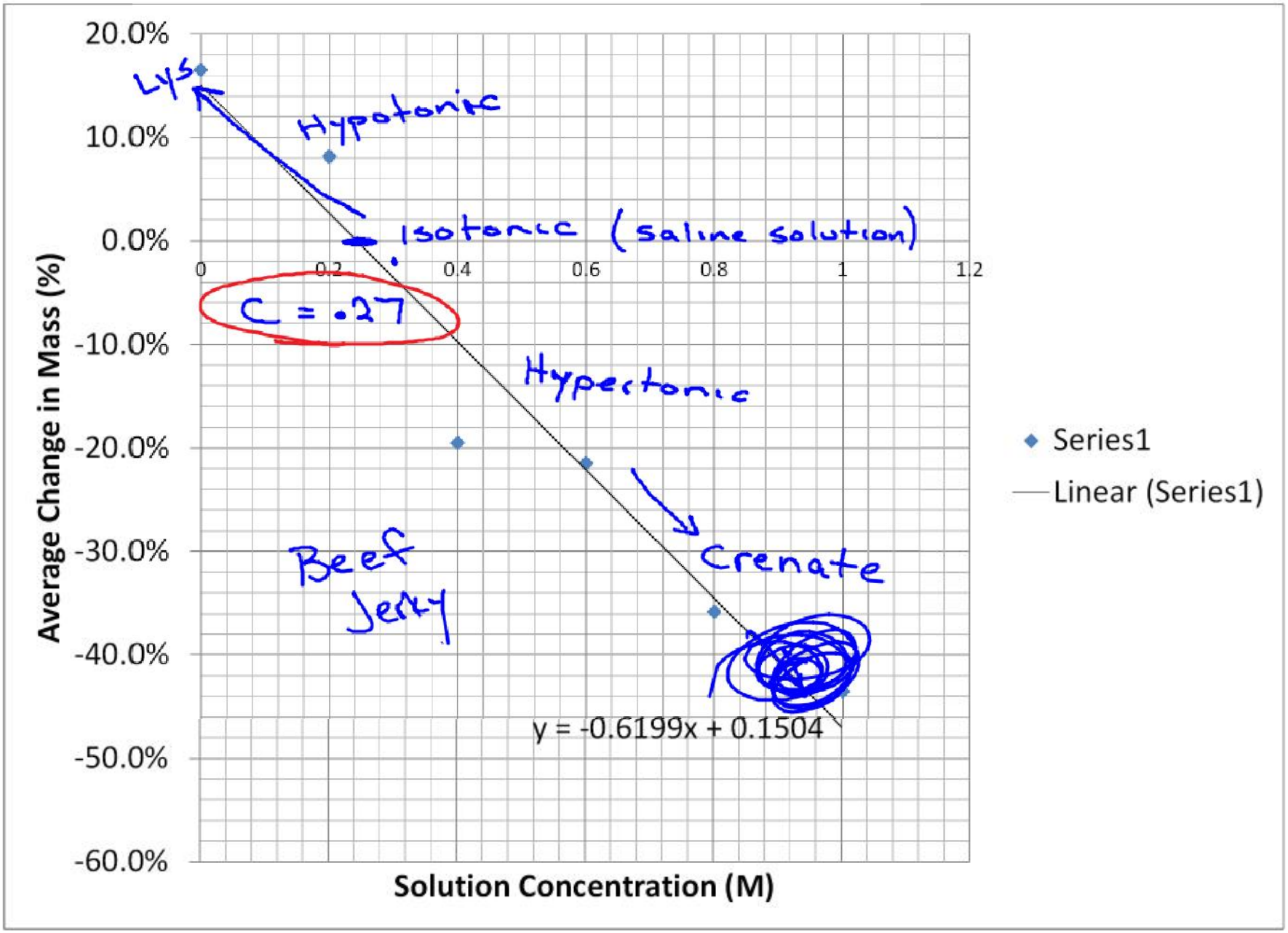
Water Potential



Contents of Beaker	Percent Change In Mass of Potato Cores						
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
0.0 M Distilled	16.0%			17.0%			
0.2 M Sucrose		3.4%			11.9%		9.1%
0.4 M Sucrose			-14.0%	-25.0%			
0.6 M Sucrose	-23.0%				-20.0%		
0.8 M Sucrose		-33.3%				-33.3%	-40.9%
1.0 M Sucrose			-47.0%			-40.0%	

Total % change	Class Average	
33.0%	16.5%	0
24.4%	8.1%	0.2
-39.0%	-19.5%	0.4
-43.0%	-21.5%	0.6
-107.5%	-35.8%	0.8
-87.0%	-43.5%	1

AP Biology Lab 1c: Calculation of Water Potential from Experimental Data

i =	The number of particles the molecule will make in water; for NaCl this would be 2; for sucrose or glucose, this number is 1
C =	Molar concentration (from your experimental data) .27
R =	Pressure constant = 0.0831 liter bar/mole K
T =	Temperature in degrees Kelvin (273 + °C of solution)

X intercept

Usually irrelevant

1. The **solute potential** of this sucrose solution can be calculated using the following formula:

Solute potential (Ψ_s) = -iCRT

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

- A 1.0 M sugar solution at 22 °C under standard atmospheric conditions

  Ψ_s = -i (C) (R) (T)

  $$\psi_s = -(1)\left(1.0\ \frac{\cancel{\text{mole}}}{\cancel{\text{liter}}}\right)\left(0.0831\ \frac{\cancel{\text{liter}}\ \text{bar}}{\cancel{\text{mole}}\ \text{K}}\right)(295\ \text{K})$$

  Ψs = -24.51 bars

1. In an open system with only atmospheric pressure, the same amount of force is acting on both the beaker and the cells in it. That allows us to assume that the **pressure potential (ψ_p) of any open system is Zero**. Knowing the solute potential of the solution (ψ_s) and knowing the pressure potential of the solution is zero (ψ_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.

$\psi = \psi_p + \psi_s$

$\psi = 0 + \psi_s$

$\psi = \psi_s$

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? Show your calculations here.

2. Water potential values are useful because they allow us to predict the direction of the flow of water. Suppose that a student calculates the water potential of a solution inside a bag is -6.25 bar and the water potential of a solution surround the bag is -3.25 bar. In which direction will the water flow?.....Water will flow into the bag. This occurs because there are more solute molecules inside the bag (therefore a value further away from zero) than outside the solution.

Analysis Questions

1. If a potato core is allowed to dehydrate by sitting in open air, would the water potential of the potato cells decrease or increase? Why?

2. If a plant cell has a lower water potential 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 water or lose water? Explain.

3. Consider what would happen to a red blood cell placed in distilled water:
   a. Which would have the higher concentration of water molecules? (Distilled water or Red Blood Cells)
   b. Which would have the higher water potential? (Distilled water or Red Blood Cells)
   c. What would happen to the red blood cell? Why?

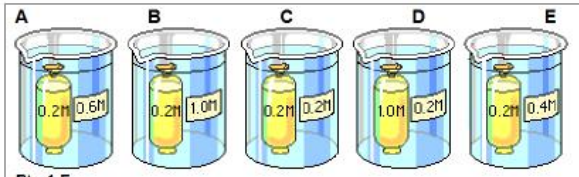


Fig 1.5

4. In Figure 1.5 the beakers are open to the atmosphere. What is the pressure potential (IvP) of the system?

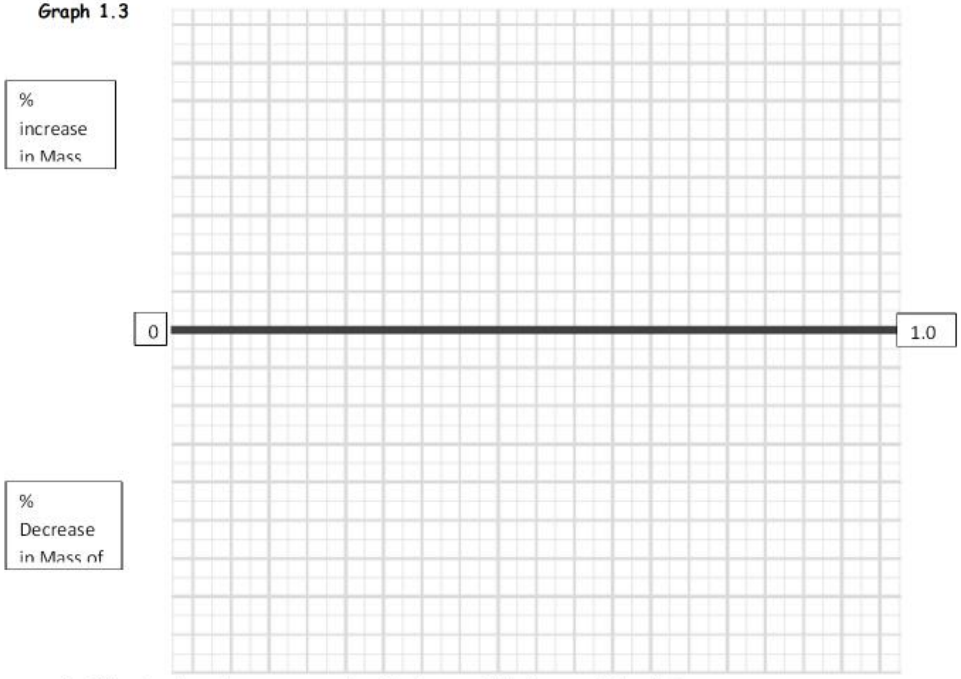
5. For each of the examples in Figure 1.5 circle where the greatest water potential is and which way water will want to move?
   A. beaker /dialysis bag Into cell / out of cell
   B. beaker /dialysis bag Into cell / out of cell
   C. beaker /dialysis bag Into cell / out of cell
   D. beaker /dialysis bag Into cell / out of cell
   E. beaker /dialysis bag Into cell / out of cell

6. Zucchini cores placed in sucrose solutions at 27°C resulted in the following percent changes after 24 hours:

% Change in Mass	Sucrose Molarity
20%	Distilled Water
10%	0.2 **M**
−3%	*0.4M*
−17%	0.6 **M**
−25%	0.8 **M**
-30%	*1.0 M*

7. Graph the results on Graph *1.3*.

Graph 1.3



8. What is the molar concentration of solutes within the zucchini cells?

8. Refer to the procedure for calculating water potential from experimental data (page 6).

   a. Calculate solute potential (ψ_s) of the sucrose solution in which the mass of the zucchini cores does not change. Show your work here:

   b. Calculate the water potential (ψ) of the solutes within the zucchini cores. Show your work here:

9. What effect does adding solute have on the solute potential component (ψ_s) of that solution? Why?

10. Consider what would happen to a red blood cell (RBC) placed in distilled water:

   a. Which would have the higher concentration of water molecules? (Circle one.)

      Distilled H_2O **RBC**

   b. Which would have the higher water potential? (Circle one.)

      Distilled H_2O **RBC**

   c. What would happen to the red blood cell? Why?