FLINN SCIENTIFIC

Name_____

Data Tables

Part 1. Osmosis

Boiling Point of Water _____ °C

Beaker	Mass Glucose Added (g)	Boiling Point (°C)	Observations of Dialysis Tubing Solution
1			N/A
2			
3			—
4		N/A	—

Part 2. Freezing Point Depression

Temperature of Pure Ice–Water Mixture = _____°C

Beaker Number	Additive to Ice–Water Mixture	Mass of Ice + Water (g)	Mass of Additive (g)	Lowest Temperature of Mixture (°C)
1	Sodium chloride, NaCl	_____	_____	_____
2	Calcium chloride, $CaCl_2$ $2H_2O$	_____	_____	_____
3	Glucose, $C_6H_{12}O_6$	_____	_____	_____

Part 3. Boiling Point Elevation

Solution	Boiling Point (°C)	Boiling Point Elevation (°C)
Distilled Water		—
1.0 M NaCl		
4.0 M NaCl		

Calculations *(Use a separate sheet of paper to answer the following questions.)*

Part 1. Osmosis

1. Calculate the initial molality of beakers #1 and #2 and beakers #3 and #4. (molality = moles solute/kg solvent) (Molar mass of glucose = 180.16 g/mole. Assume mass of water is 0.1000 kg)
2. For boiling point elevation,

$$\Delta T = K_b m \quad \text{or} \quad m = \frac{\Delta T}{K_b}$$

K_b for water equals 0.512 Kg•K/mol

a. Calculate the concentration of glucose in beakers #1 and #3 from their boiling point data and compare these calculated values to the actual concentrations.

b. The initial concentration of the solution in beaker #2 was the same as that in beaker #1. Compare the boiling point of the solution in beaker #2 after osmosis (step 18) with the boiling point of the solution in beaker #1. Explain the difference.

Part 2. Freezing Point Depression

Use the results in the Part 2 Data Table to answer the following questions.

1. Using the same mass of additive (i.e., 20 g), which additive to the ice water lowered the freezing point the most (with the greatest ΔT_f)?
2. Using the same mass of additive (i.e., 20 g), which additive to the ice water lowered the freezing point the least (with the lowest ΔT_f)?
3. Which additive had the greatest freezing point depression per mole? Which had the least? Is this what would be expected? Explain.
4. What should be true about the freezing point depression per particle or ion? Does your data verify this?
5. What factors were held constant in this experiment?
6. Given the following sample cost data, which deicing chemical would you recommend as the most cost-effective agent for preventing road icing? Explain.

Sample cost data:	*Additive*	*Cost/kg*
	Sodium chloride	$ 0.64
	Sucrose	$ 0.79
	Calcium chloride, dihydrate	$ 0.77
	Aluminum chloride, hexahydrate	$ 2.76

Part 3. Boiling Point Elevation

1. From the values of ΔT_b (boiling point elevation) for each of the sodium chloride solutions, estimate the boiling point elevation constant. Substitute the molarity values for molality in Equation 1.

$\Delta T_b = K_b m$
$K_b \approx \Delta T_b / M$

2. How does using the molarity in place of molality affect the estimate of K_b?