Solutions and Osmolality

Objective:

To measure osmolality and to explain the importance of maintaining osmolarity at critical values in the body, at the level of 85% proficiency for each student.

In order to achieve this objective, you will need to be able to:

1. Define *molarity, and osmolarity*.
2. Calculate and measure osmolarity.

Materials

Group Supplies

100 ml graduated cylinder
3 - 250 ml beaker
3 - 50 ml beakers

Lab Supplies (per table in lab)

0.05 M NaCl (in dropper bottle)
0.15 M NaCl (in dropper bottle)
2 test tubes
20% potassium chromate (K_2CrO_4) solution (K) (in dropper bottle)
2.9% silver nitrate ($AgN0_3$) (in dropper bottle)

Introduction

Molarity is the number of moles of a molecule in a liter of solution. Osmolarity is the number of solute particles (ions) in a liter of solution. If the molecules do not dissociate in solution, the osmolarity and the molarity are the same number. If the molecules dissociate in solution the osmolarity will be a multiple of the number of particles (ions) into which each molecule dissociates. For example,

- Glucose ($C_6H_{12}O_6$) does not dissociate in water:
  1 M/L Molarity = 1 M/L Osmolarity = 1 Osm/L
- NaCl dissociates in water into 2 ions (Na^+, Cl^-):
  1 M/L Molarity = 2x1 M/L = 2 M/L Osmolarity = 2 Osm/L

Methods:

Use two pre-made aqueous solutions of sodium chloride (NaCl) as listed in Table 1. Calculate the quantity of NaCl in grams per liter (g/L) for each solution. Measure the NaCl concentration and calculate the osmolarity of the solutions.

Measurement of Sodium Chloride (NaCl) Concentration:

- Measure 10 drops of each of the solutions into test tubes using a standard medicine dropper. Add 1 drop of 20% potassium chromate (K_2CrO_4) solution to the solution in each test tube.
- Add 2.9% silver Nitrate ($AgN0_3$) solution 1 drop at a time to the solution in each test tube using the dropper in the bottle. Vigorously swirl the test tube after each drop of silver nitrate added.
- Count the drops of silver nitrate solution required to turn the solution from a bright yellow to an orange brown, color.
- Each drop of 2.9% silver nitrate ($AgN0_3$) required to produce the color change represents approximately 1 gram/liter (1 g/L) of NaCI.

Results:

Table 1 –Measurement of NaCl concentration and calculation of osmolarity of pre-made solutions of NaCl

NaCl Solution (**Moles/L**)	Calculated quantity of NaCl (**g/L**)	Measured NaCl concentration		Calculated osmolarity (**mOsm/L**)
		drops of $AgN0_3$	NaCl (**g/L**)	
0.05 M				
0.15 M				

Discussion:

1. What is the apparent relationship between molarity and osmolarity?
2. Predict the osmolarity of a 0.05 M solution of $MgCl_2$.
3. Predict the osmolarity of a 0.05 M solution of HCl.