Solutions and Osmolarity

Objective:

To measure osmolarity and to explain in a short essay 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.
3. Prepare solutions of various NaCl concentrations and thus of various osmolarities.

Materials

Group Supplies

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

Lab Supplies

- Freezing Point Depression Osmometer
- Pipetter with 250 microliter pipette tips
- 0.05 M NaCl
- 0.15 M NaCl
- NaCl
- distilled water
- balance
- 2 - 4 test tubes
- 20% potassium chromate solution (in dropper bottle)
- 2.9% silver nitrate (in dropper bottle)
Methods:

1. Predict and measure the NaCl concentration and osmolarity of the pre-made solutions listed in Table 3.

2. Prepare four concentrations of NaCl as listed in Table 4. You must determine the number of grams of NaCl that must be added to distilled water to make 100 ml of solution with these concentrations. For each solution prepared, predict and measure the NaCl concentration and the osmolarity.

Measurement of Sodium Chloride Concentration:

- Measure 10 drops of each of the solutions in Table 3 and Table 4 into test tubes using a standard medicine dropper. Add 1 drop of 20% potassium chromate solution to the solution in each test tube.
- Add 2.9% silver Nitrate 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 required to produce the color change represents approximately 1 gram/liter of NaCl.

Results:

<table>
<thead>
<tr>
<th>NaCl Solution (moles/L)</th>
<th>predicted NaCl concentration (gm/L)</th>
<th>measured NaCl concentration (gm/L)</th>
<th>predicted osmolarity (moles/L)</th>
<th>measured osmolarity (moles/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>drops of AgNO₃</td>
<td>NaCl (gm/L)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05 M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.15 M</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Table 4 – Preparation of solutions of NaCl and prediction and measurement of their NaCl concentration and osmolarity

<table>
<thead>
<tr>
<th>desired molarity (millimoles/L)</th>
<th>volume of solution to make (gm/L)</th>
<th>predicted amount of NaCl needed (gm/100 mL)</th>
<th>measured NaCl concentration (gm/L)</th>
<th>predicted osmolarity (moles/L)</th>
<th>measured osmolarity (moles/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mM</td>
<td>100 mL</td>
<td>drops of AgNO₃ NaCl (gm/L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 mM</td>
<td>100 mL</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>200 mM</td>
<td>100 mL</td>
<td></td>
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</tbody>
</table>

Discussion:

1. What is the apparent relationship between molarity and osmolarity?
2. Predict the osmolarity of a 0.05 M solution of MgCl₂.
3. Predict the osmolarity of a 0.05 M solution of HCl.