**Observations of Solutions at Various Time in the Freezer**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Solution | Time: 0:00 | Time:  0.30 | Time:  1:00 | Time:  1:30 | Time:  2:00 | Time:  2:30 | Time:  3:00 |
| A | liquid |  |  |  |  |  |  |
| B | liquid |  |  |  |  |  |  |
| C | liquid |  |  |  |  |  |  |
| D | liquid |  |  |  |  |  |  |
| E | liquid |  |  |  |  |  |  |

**Questions:**

1. Based on your observations and your answers to calculation step 3, give a range of the approximate temperature of your freezer. Explain your reasoning.
2. Does tap water (or freshwater) really freeze at 0°C? Why or Why not?
3. The maximum solubility of table salt, NaCl (*i =*2) in water at 0°C is 35.7 g NaCl / 100 g H2O.

a. Calculate the maximum molality of a NaCl solution in water at 0°C

b. Calculate the maximum freezing point depression for this NaCl solution.

1. The maximum solubility of the sugar sucrose, C12H22O11, in water at 0°C is 180 g C12H22O11/ 100 g H2O, a value much higher than that for NaCl. However, sucrose is NOT an electrolyte like NaCl (so *i =*1).

a. Calculate the maximum molality of a C12H22O11 solution in water at 0°C

b. Calculate the maximum freezing point depression for this C12H22O11

solution.

1. The maximum solubility of the salt magnesium chloride, MgCl2 (*i =*3) in water at 0°C is 52.9 g NaCl / 100 g H2O.

a. Calculate the maximum molality of a NaCl solution in water at 0°C

b. Calculate the maximum freezing point depression for this NaCl solution.

6. Graph the molarity of each solution (*x-axis*) versus the calculated freezing

point (°C) of each solution. If ocean water freezes at -1.9°C, determine the

approximate molality of the ocean, assuming it is primarily a NaCl solution.

7. Why is MgCl2 used on highways when the temperature reaches freezing at 0°C? At

what temperature should the highway department stop using NaCl? How might the

highway department keep the roads from freezing even below the temperature you

mentioned? What might be a side effect of using either NaCl or MgCl2 on the roads?