**Determining the Molal Boiling Point Elevation Constant**

The boiling point of a solvent will be increased with the addition of a nonvolatile solute. This occurs because the solute increases the intermolecular attractions in the solution, interfering with the energy it takes to make the solvent boil. As the solution begins to boil, the temperature continues to rise since the concentration of the solution is increased as the solvent boils away.

Urea, H2NCONH2, is an organic compound that is soluble in ethanol but does not dissociate. Ethanol’s boiling point at standard conditions is 78.37 degrees Celsius. Due to the conditions in the room, the experimental value for boiling point of pure ethanol must be determined before it can be compared to boiling point of an ethanol solution.

**Procedure:**

1. Completely fill a 1000 mL with **tap** water (**do not use distilled water**) and place the beaker on a hot plate set on high.
2. Set up the LabPro unit with LoggerPro.
3. Plug the connector for the temperature probe into CH1 (channel 1) of the LabPro unit. Plug in the interfacing cable at the side of the LabPro and the USB port of the computer.
4. Launch the program called “LoggerPro” in the Science and Tools folder on the desktop. It should automatically recognize that the temperature probe is connected.
5. At the top of the program, click on “Experiment” and then “Data Collection”. Set the duration to 3000 seconds and the put 3 seconds/per sample. So the graph will take the temperature every 3 seconds.
6. Get a medium sized test tube and wrap a thin strip of paper towel around the top, securing it in place with tape. Place the test tube in a large test tube. Make sure the medium test tube fits inside the large test tube without slipping down or having a large part sticking up at the top.
7. Measure out 20 mL of ethanol and put it in the medium sized test tube.
8. Secure the test tube apparatus in a test tube clamp on a ring stand. In a separate test tube holder, secure a temperature probe above the test tubes.
9. Bring the ring stand apparatus near the hot water bath. Lower the test tube apparatus into the hot water bath. Lower the temperature probe so it inside the test tube and is not touching any of the sides of the test tube.
10. When the temperature of the ethanol reaches 50.0 degrees Celsius start the data collection.
11. When the ethanol is visually boiling stop the data collection when there are 10 consecutive samples of the same temperature. This is the experimental value for the boiling point of pure ethanol.
12. Carefully pull the test tube clamp that is holding the temperature probe out of the ethanol and to the side of the other clamp holding the test tube apparatus. Using rubber pads, hold the large test tube and remove it to from the clamp. Place the test tubes in 200 mL beaker to cool down.
13. Measure 1.200-1.500 grams of urea crystals to the nearest thousandths place.
14. Ensemble another test tube apparatus as before and place the urea in the smaller test tube.
15. Measure and add 20 mL of ethanol to the small test tube. Use a pipette to stir and mix the urea until it is completely dissolved in the ethanol. This step may take time, to speed up the process, squeeze the pipette to blow the crystals into solution.
16. Repeat steps 5-9.

**Calculations:**

1. Find the molality of the ethanol solution with the urea.
2. Find the molal boiling point elevation constant (Kb) for ethanol.
3. Using the standard molal boiling point elevation constant located on page 534 in your textbook, calculate the percent error.