Laboratory Investigation Name _____

Chemistry: Form L8.4A Date _____ Period _____

Measuring Molal Boiling Point Elevation

PROBLEM

How does the presence of dissolved solute affect the boiling point of water?

INTRODUCTION

A substance boils when its vapor pressure equals atmospheric pressure. As the temperature of a liquid increases, the particles begin to move faster and spread apart to form a gas. The particles escaping from the surface of a liquid exert pressure known as vapor pressure. The presence of nonvolatile solute reduces the concentration of particles turning into vapor, thereby lowering the vapor pressure at a given temperature. This causes the boiling point to increase. In this laboratory investigation you will measure the boiling point elevation of electrolyte and nonelectrolyte solutions.

MATERIALS (*per group*)

Bunsen burner; electrolyte solutions (1m, 2m, 3m, and 4m); nonelectrolyte solutions (1m, 2m, 3m, and 4m); safety goggles; test tube rack; test tube holder; test tubes (5); thermometer

PROCEDURE

1. Record the names of the electrolyte and nonelectrolyte solutions you are using in the data table on the next page.

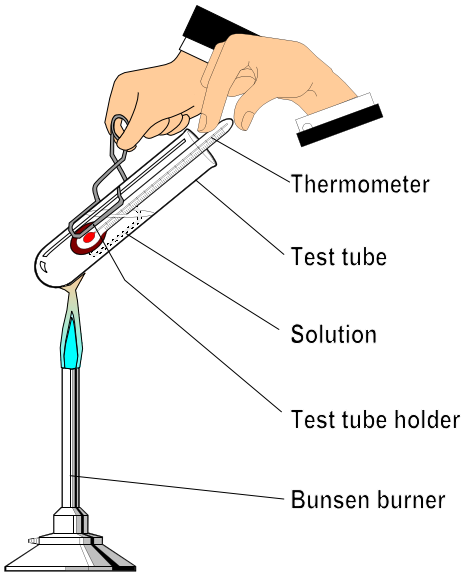
2. Fill a test tube about one fourth of the way with deionized or distilled water. Pure water is a solution with a concentration of 0m.

3. Put on safety goggles and light your Bunsen burner. Pick up the test tube containing the solution with a test tube holder. Measure the boiling point of the solution by moving the test tube carefully back and forth through the flame and stirring the solution in the test tube with a thermometer. *CAUTION: Do NOT point the open mouth of the test tube toward anybody.* As soon as the solution in the test tube begins to boil, record the temperature in the data table on the next page. (NOTE: You may feel the vibrations before you see the solution bubbling.)

4. Measure the boiling points of the remaining solutions by repeating step 3 with a quarter test tube of each.

5. Prepare a graph on a separate sheet of graph paper with concentration on the *X*-axis and boiling point on the *Y*-axis. Plot the points for the electrolyte and nonelectrolyte on the same axis using ⊙ to represent the electrolyte points and ⊗ to represent the nonelectrolyte points. The boiling point of pure water represents a 0m solution for both the electrolyte and the non electrolyte. Draw the best straight line for each set of points (**a separate line for the electrolytes and the nonelectrolytes**).

6. Find the molal boiling point elevation for the electrolyte and nonelectrolyte solutions by determining the absolute value of the slopes of each of the lines. Record the results in the data table on the next page. Note whether the electrolyte and nonelectrolyte are the same.



7. The accepted value for the molal boiling point elevation is 0.52°C/mol. Perform an error analysis using the observed value for the nonelectrolyte by finding, first, the absolute error, and, then, the percentage error.

OBSERVATIONS

Concentration	Boiling Point	
	Nonelectrolyte NAME: _____	Electrolyte NAME: _____
0m (water)		
1m		
2m		
3m		
4m		
slope		

Error Analysis

1. Observed molal boiling point elevation for nonelectrolyte . . . . . _____
2. Accepted value for molal boiling point elevation . . . . . _____
3. Absolute error . . . . . _____
4. Percentage error . . . . . _____

CONCLUSIONS

1. Why is the slope of the line the molal boiling point elevation? _____

2. What causes boiling point elevation? _____

3. What are the likely sources of error in this laboratory investigation? _____

4. What is the expected boiling point of 2m $KNO_3(aq)$? _____
5. Why is antifreeze left in the automobile radiator during the summer? _____