

Graph and Calculations

Graph the cooling data as shown in Figure 1.

From your graph, determine the freezing points of the solvent and each of the solutions, and the values of ΔT_{fp} . Calculate the freezing point depression constant from the molality and ΔT_{fp} of the cetyl alcohol solution. Calculate the molar mass of the unknown solute using the freezing point depression constant, the mass of the unknown solute, and the mass of BHT. Enter these values in the Calculation Table.

Data Tables

	Trial #1	Trial #2
Mass of empty test tube #1, g		
Mass of test tube #1 plus BHT, g		
Mass of BHT, g		
Mass of weighing paper, g		
Mass of weighing paper plus cetyl alcohol, g		
Mass of cetyl alcohol, g		
Mass of empty test tube #2, g		
Mass of test tube #2 plus BHT, g		
Mass of BHT, g		
Mass of unknown, g		

Cooling Data Table

Time, in Seconds	Temperature in °C		
	Pure BHT	BHT + Cetyl Alcohol	BHT + Unknown

Calculation Table

	BHT	BHT + Cetyl Alcohol	BHT + Unknown
Freezing Point, °C			
ΔT_{fp} , °C	—		
k_{fp} , °C/m		—	—
Molar mass, g/mole	—	—	
% error, molar mass	—	—	

Post-Lab Questions *(Show all work on a separate sheet of paper.)*

- The following errors occurred when the above experiment was carried out. How would each affect the calculated molar mass of the solute (too high, too low, no effect)? Explain your answers.
 - The thermometer used actually read 1.4 °C too high.
 - Some of the solvent was spilled before the solute was added.
 - Some of the solute was spilled after it was weighed and before it was added to the solvent.
 - Some of the solution was spilled after the solute and solvent were mixed but before the freezing point was determined.
- What was the least precise measurement in the experiment? How does this limit your significant digits?
- Did the solutions show any evidence of supercooling?
- Why is it advantageous to choose a solvent that has a large value for K_{fp} ?
- Explain why the pure solvent shows a level horizontal curve as solidification occurs, but the curve for the solution slopes downward slightly.

Calculations

Determine ΔT_{fp} for the solution of cetyl alcohol and of the unknown substance in BHT. Calculate the molality of the cetyl alcohol solution and use it to determine the value of the freezing point depression constant, k_{fp} , for BHT. Use the calculated value of k_{fp} , along with the masses of the unknown solute and BHT, to find the molar mass of the unknown solute.

Data Tables. Microscale Procedure

Melting Points

Pure BHT	°C
BHT + cetyl alcohol	°C
BHT + unknown	°C

Masses

	BHT	Cetyl Alcohol	Unknown
Solution #1 — BHT + Cetyl Alcohol, g			
Solution #2 — BHT + Unknown, g			

Calculations

k_{fp} , BHT, °C/m _____ °C/m

Molar mass, unknown, g/mole _____ g/mole