Determination of kf for naphthalene

Science, Chemistry

To determine the Kf for naphthalene, we need to find the difference in the freezing point of pure naphthalene and the solution of 1, 4-dichlorobenzene in naphthalene. Let's say that we did this experiment, used 1. 00 g 1, 4-dichlorobenzene in 10. 00 g naphthalene, and found that the freezing temperature of pure naphthalene was 78. 2°C, while that of the solution was 75. 4°C. This gives us a Δ Tf of 78. 2°C - 75. 4°C = 2. 8°C.

Using the equation for freezing pointdepressionand solving for Kf, we have... ΔTf = Kfmsolute Kf = Δ Tf/msolute where msolute equals the molality of the solute. What is the molality of the solute?

msolute= molality of solute = moles of solute/kg solvent

moles of solute = 1. 00 g 1, 4-DCB/146. 9 g/mol = 6. 81 x 10-3 moles 1, 4-DCB kg of solvent = 10. 00 g naphthalene/1000 g/kg = 0. 01 kg solvent msolute = 6. 81 x 10-3 moles 1, 4-DCB/0. 01 kg naphthalene = 0. 681 m Kf = 2. 8°C/0. 681 m = 4. 112 K·kg/mol

The actual value for Kf for naphthalene is 7. 45 K·kg/mol, so we're a fair amount off the mark.

This is a rather crude experiment, so that's to be expected.

Determination of the Molecular Mass/Molecular Formula of Elemental Sulfur

Although this experiment didn't go as well as I would have liked, there seemed to be some problems with the interpretation of the data as they were obtained, so I thought I'd demonstrate how to do this calculation. Elemental sulfur has a molecular formula of S8 (there are 8 sulfur atoms in a molecule of sulfur, just like there are 2 hydrogen atoms in a molecule of hydrogen). So, the purpose of this experiment was really just to see how close you could come to this answer.

Practice test: answer key

To find the molar mass (and, using the atomic mass, the molecular formula) for sulfur, we first need to find the freezing point of a solution of sulfur in naphthalene. Let's say we made such a solution with 0. 500 g powdered sulfur in 10. 00 g of naphthalene and we found that its freezing point was 76. 7°C. To find the molecular mass, let's first find the molality of the solution by solving the above equation for msolute. (NOTE: Contrary to what many of you thought, you can't find the molality of this solution just by using the atomic mass of sulfur to find the moles of sulfur... remember that molecular sulfur has 8 sulfur atoms, but for the purposes of your experiment, you " don't know this" and are trying to find that fact out. So, we're solving for the molar mass just like the problem on the most recent exam involving an unknown solute.)

Δ Tf = Kfmsolute msolute = Δ Tf/Kf

Our Δ Tf = 78. 2°C - 76. 7°C = 1. 5°C.

Let's use the " real" Kf instead of the one we calculated so we'll get a better answer... msolute = 1. 5°C/7. 45 K·kg/mol = 0. 201 mol/kg (molal) Now, we know the molality, and we know the number of kilograms of solvent (0. 010 kg of naphthalene) - let's find the number of moles of sulfur present.

Moles of sulfur = molality x kg of solvent = 0. 201 m x 0. 010 kg = 0. 00201 moles sulfur

Now, divide the mass of sulfur we took by this number of moles to get the molar mass of sulfur... 0. 500 g sulfur/0. 00201 moles sulfur = 248. 8 g/mol

This is the molar mass of elemental sulfur... divide it by the atomic mass of sulfur (32. 07 g/mol) to find out how many sulfur atoms there are in a sulfur molecule. We get 7. 76 ? 8 atoms... isn't it cool how you can get the right answer when you make up your own data?