

Additional Teacher Background

Chapter 5, Lesson 9, p. 453

The idea of counting molecules was discussed in the Additional Teacher Background section in lesson 1. There, the question was whether it was fair to do an evaporation test between water and alcohol using one drop of each when these drops contain a different number of molecules. It was explained that there is a way to “count” molecules using the atomic mass and the mole concept. In this way, if needed, an evaporation test could be conducted using the same number of molecules of alcohol and water.

Here, the question is whether it is fair to compare the temperature change when equal masses of two different substances are dissolved. Again, since substances are composed of different atoms, they have different masses. So comparing the same mass of two different substances means that each sample contains a different number of particles.

For example, an equal mass of calcium chloride and potassium chloride must have a different number of units of each substance. Calcium chloride is CaCl_2 with a mass of $40 + 2(35.5) = 111$. This means that 111 grams of calcium chloride contain one mole or 6.02×10^{23} calcium chloride units.

Potassium chloride is KCl with a mass of $39 + 35.5 = 74.5$. This means that 74.5 grams of potassium chloride contains one mole or 6.02×10^{23} potassium chloride units. So it takes fewer grams of potassium chloride to have the same number of units as calcium chloride. This means that if you dissolve equal masses of these substances, you are actually using more units of potassium chloride than calcium chloride.

If you wanted to use the same number of units of each, you would need to use masses that are in the same ratio as 111 grams calcium chloride / 74.5 grams potassium chloride which is very close to 1.5/1.