ChemQuest 54

*More Units of Concentration*

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hour: \_\_\_\_\_

**Information**: Molality

Molality is another way of expressing solution concentration. The symbol for molality is m. Whereas molarity (M) represents the ratio of moles solute to liters of solution, the molality (m) is the ratio of moles solute to kilograms of solvent. It can be expressed using the following formula:



**Critical Thinking Questions**

1. Consider a solution that is prepared by adding 1.34 moles of sodium nitrate to 2.5 kg of water. What is the molality of the solution?
2. Considering the data given in question 1, is this enough data to find the molarity? If so, calculate the molarity. If not, explain why not.
3. What is the molality of a solution that is made by dissolving 32.6 g of Na2SO4 in 475 g of water?
4. Consider 2.35 moles of sodium chloride are dissolved in 1.21 kg of solution to make 1.29 liters. Calculate and compare the molarity and molality.
5. If 26.45g of Na2SO4 are dissolved in 1.10 kg of solution to make 1.24 L, calculate both the molarity and the molality of the resulting solution.

**Information**: Mole Fraction

Another way of expressing solution concentration is called “mole fraction”. The mole fraction (symbolized by X) of the solute or of the solvent can be calculated using the following equations:

 

Note: both the solute and the solvent must be converted to moles when finding the mole fraction!

**Critical Thinking Questions**

1. Prove that the mole fraction of salt (XNaCl) equals 0.049 when 14.25 g of NaCl is dissolved in 85.0 g of H2O.
2. Find the mole fraction of water (Xwater) for the solution described in question 12.
3. Prove that Xsolute + Xsolvent = 1.
4. In a certain salt water solution, the mole fraction of salt is 0.18. Find the mole fraction of water.

**Information**: Mass Percent Composition

Mass percent composition is similar to the mole fraction except the amounts of solute and solvent are in grams instead of moles. Here is the formula for finding the mass percent of a solute:



**Critical Thinking Questions**

1. Prove that the mass percent of salt is 14.36% in the solution described in question 6.
2. Calculate the mass percent of sodium phosphate if 12.5g of it are dissolved in 250 mL of water. (Note: 1 mL of water has a mass of 1 g.)