ChemQuest 53

Molarity

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

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

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

**Introductory Questions**

1. Consider two solutions:

Solution A

Made by dissolving 4 grams of salt in 120 mL of water.

Solution B

Made by dissolving 6 grams of salt in 350 mL of water.

* 1. Which solution contains the most salt?
  2. Which solution would taste the saltiest if you drank some?
  3. You’ve probably heard the term “concentrated” before. There’s concentrated orange juice and concentrated dish soap. Above, the solution that tastes the saltiest is the most concentrated. What does it mean to say that a solution is “concentrated”?

1. Consider two more solutions:

Solution Y

Made by dissolving 20 grams of salt in water.

Solution X

Made by dissolving 12 grams of salt in water.

Why can’t you tell which solution is the most concentrated?

**Information**: Concentration

In the introductory questions, hopefully you have discovered that you need two pieces of information to know how concentrated a solution is—(1) the amount of solute dissolved and (2) the volume of the liquid.

Here’s a formula to calculate the concentration of a solution. Concentration is given in units called, “molarity.”

 or in symbols: 

Also, remember that to get moles from grams you can use this equation: 

**Critical Thinking Questions**

1. A solution is made by dissolving 24 g of NaCl to make 475 mL of solution. Calculate the concentration in units of molarity by following these steps:
   1. Convert the grams of NaCl to moles of NaCl.
   2. Calculate the liters of solution by dividing the given milliliters by 1000.
   3. Divide moles by the liters of solution.
2. Calculate the concentration (in units of molarity) of the following solutions:
   1. 42.1 g of Ca(NO3)2 in 700 mL of solution.
   2. 25.9 g of Na2SO4 in 575 mL of solution.
3. Verify that I need 2.15 moles of Ca(NO3)2 to make 358 mL of a 6.00 molar solution.
4. Verify that it takes 80.8 g of sodium chloride to make 425 mL of a 3.25 M solution.
5. Consider 670 mL of a 4.10 M solution of Mg(NO3)2 setting in a beaker. If you evaporate all 670 mL of the solution, how many grams of solute would be left in the beaker?

**Information**: Dissociation (Breaking Into Ions)

When an ionic compound dissolves it dissociates, or breaks up into ions. Calcium chloride dissociates as follows: CaCl2 🡪 Ca+2 + 2 Cl-

Note that for each CaCl2 that dissolves there are two Cl- ions and one Ca+2 ion in the solution. So if one mole of calcium chloride ions dissolve you will have two moles of Cl- ions and one mole of Ca+2 ions in solution. Notice also that chloride ions are written “Cl-” and NOT “Cl2”. The reason for this is that chlorine *atoms* are diatomic, but chlorine *ions* are not.

**Critical Thinking Questions**

1. If you dissolve 3.5 moles of CaCl2 in solution, how many moles of Ca+2 ions and Cl- ions will there be in the solution?
2. Consider a 2.5 M solution of CaCl2. (The “M” stands for molarity, so the concentration of CaCl2 is 2.5 M—meaning that there are 2.5 moles of CaCl2 in each liter of solution.)
   1. What is the concentration of Ca+2 ions in the solution?
   2. What is the concentration of Cl- ions in the solution? (Hint: remember that there is twice as much Cl- as there is CaCl2 because of the balanced equation.)
3. Write the dissociation equation for dissolving Na3P.
4. Calculate the molarity of a solution of Na3P formed by dissolving 85 grams of it to make 720 mL of solution.
5. Given your answer to question 11 and the reaction you wrote in question 10, calculate the molarity of the sodium ions (Na+) in the solution.
6. Write the dissociation equation for Al(NO3)3.
7. Calculate the molarity of a solution of Al(NO3)3 formed by dissolving 65 grams of it to make 875 mL of solution.
8. Given your answer to question 14 and the reaction you wrote in question 13, calculate the molarity of the nitrate ions (NO3-) in the solution.