Chemistry: Form WS8.2.2A Name _____

SOLUTIONS Date _____ Period _____

Molarity

One of the most useful measures of concentration in chemistry is molarity (M). Molarity is the number of moles of solute per liter of solution. A two molar (2 M) solution contains two moles of solute per liter of solution.

$$M = \frac{moles(solute)}{L(solution)}$$

A two molar solution

Recall that the number of moles is determined by dividing the number of grams by the gram formula mass (GFM). There are a number of formulas for calculation that come from these relationships:

- $M = \frac{g}{GFM \times L}$
- $moles = M \times L$
- $g = M \times GFM \times L$

Below are some sample problems that show how to apply these formulas.

Sample Problem 1

Find the molarity of 100. mL of a solution that contains 0.25 moles of dissolved solute.

Step 1: Convert all volumes to liters

$$100.mL \times \frac{0.001L}{1mL} = 0.100L$$

Step 2: Substitute values into the definitional equation

$$M = \frac{mol}{L} = \frac{0.25mol}{0.100L} = 2.5M$$

Sample Problem 2

Find the molarity of 500. mL of a solution that contains 4.9 g of dissolved sulfuric acid (H_2SO_4).

Step 1: Find the GFM

H = 1 × 2 = 2
S = 32 × 1 = 32
O = 16 × 4 = 64
98

Step 2: Convert all volumes to liters

$$500.mL \times \frac{0.001L}{1mL} = 0.500L$$

Step 3: Substitute values into the correct equation

$$M = \frac{g}{GFM \times L} = \frac{4.9g}{(98\,g/mol)(0.500L)} = 0.10M$$

Sample Problem 3

How many moles of solute are dissolved in 250. mL of a 3.0 M solution?

Step 1: Convert all volumes to liters

$$250.mL \times \frac{0.001L}{1mL} = 0.250L$$

Step 2: Substitute values into the correct equation

$$mol = M \times L = (3.0\,mol/L)(0.250L) = 0.75mol$$

Sample Problem 4

How many grams of sodium carbonate(Na_2CO_3) are needed to prepare 250 mL of a 0.10 M solution?

Step 1: Find the GFM

Na = 23 × 2 = 46
C = 12 × 1 = 12
O = 16 × 3 = 48
106

Step 2: Convert all volumes to liters

$$250.mL \times \frac{0.001L}{1mL} = 0.250L$$

Step 3: Substitute values into the correct equation

$$g = M \times L \times GFM = (0.10\,mol/L)(106\,g/mol)(0.250L) = 2.7g$$

Answer the questions below based on the reading and the sample problems on the previous page.

1. Determine the molarity of 500. mL of a solution with 0.35 mol of dissolved solute.

2. A 200. mL sample of a solution contains 4.0 g of NaOH. What is its molarity?

3. How many grams of KNO_3 are needed to prepare 25 mL of a 2.0 M solution?

4. How many moles of $MgSO_4$ are contained in 50. mL of a 3.0 M solution?

5. How many grams of $CaCl_2$ are dissolved in 80.0 mL of a 0.75 M solution?

6. What is the molarity of 300 mL of a solution that contains 0.60 mol of dissolved ammonia?

7. What is the molarity of 5.0 L of a solution containing 200. g of dissolved $CaCO_3$?

8. How many grams of NaCl are needed to prepare 500. mL of a 0.400 M solution?

9. How many moles of solute are contained in 3.0 L of a 1.5 M solution?

10. What is the molarity of 750 mL of a solution that contains 40.0 g of dissolved $CuSO_4$?