Chemistry Name: _____

Section _____ CONCENTRATION: MOLARITY Date: _____

Concentration (molarity). Solve the following problems showing all work and unit cancellations.

1. What is the molarity of a solution in which 58.5 g of NaCl is dissolved in enough water to make 500. mL of solution?

$$molarity = \frac{moles\ of\ solute}{liter\ of\ solution} = \frac{1.00\ mol}{0.500\ L} = \boxed{2.00\ M}$$

NaCl = 58.443 g/mol $\quad 58.5\ g \times \frac{1\ mol}{58.443\ g} = 1.00\ mol$

2. What is the molar concentration of a solution made by adding enough water to 25.3 g KNO_3 to make 250 mL of solution?

$$molarity = \frac{moles\ of\ solute}{liter\ of\ solution} = \frac{0.25024\ mol}{0.250\ L} = \boxed{1.00\ M}$$

KNO_3 = 101.1032 g/mol $\quad 25.3\ g \times \frac{1\ mol}{101.1032\ g} = 0.2502\ mol$

3. How many grams of ammonia, NH_3, are required to make 1.50 L of a 0.250 M solution?

$$molarity = \frac{moles\ of\ solute}{liter\ of\ solution} = \frac{x}{1.50\ L} = 0.250\frac{mol}{L} \qquad x = 0.375\ mol$$

NH_3 = 17.0305 g/mol $\quad 0.375\ mol \times \frac{17.0305\ g}{1\ mol} = \boxed{6.39\ g}$

4. To what volume should 15 g of NaCl be diluted to prepare a 0.25 M solution?

$$molarity = \frac{moles\ of\ solute}{liter\ of\ solution} = \frac{0.25666\ mol}{x} = 0.25\ mol/L \qquad x = \boxed{1.0\ L}$$

NaCl = 58.443 g/mol $\quad 15\ g \times \frac{1\ mole}{58.443\ g} = 0.25666\ mol$

5. How many grams of magnesium sulfate heptahydrate, $MgSO_4 \cdot 7H_2O$, are required to prepare 100. mL of a 0.20 M solution?

$$molarity = \frac{moles\ of\ solute}{liter\ of\ solution} = \frac{x}{0.100\ L} = 0.20\ mol/L \qquad x = 0.020\ mol$$

$MgSO_4 \cdot 7H_2O$ = 246.47 g/mol $\quad 0.020\ mol \times \frac{246.47\ g}{1\ mol} = \boxed{4.9\ g}$

Concentration (molarity). Solve the following problems showing all work and unit cancellations.

1. How many moles of H_2SO_4 are needed to prepare 5.0 liters of a 2.0 M solution of H_2SO_4?

   $5.0\ L \times \frac{2.0\ mol}{1\ L} = 10.\ mol$

2. What is the total number of grams of solute in 500. milliliters of 1.0 M CH_3COOH (formula mass = 60. g/mol)?

   $0.500\ L \times \frac{1.0\ mol}{1\ L} \times \frac{60.\ g}{1\ mol} = 30.\ g$

3. What is the molarity of a solution that contains 40. grams of NaOH in 0.50 liters of solution?

   $40.\ g \times \frac{1\ mol}{40.0\ g} \div 0.50\ L = 2.0\ M$

4. What is the molarity of a solution of KNO_3 (gram-formula mass = 101 g/mol) that contains 404 grams of KNO_3 in 2.00 liters?

   $404\ g \times \frac{1\ mol}{101\ g} \div 2.00\ L = 2.0\ M$

5. What is the molarity of an H_2SO_4 solution if 0.25 liters of the solution contains 0.75 moles of H_2SO_4?

   $\frac{0.75\ mol}{0.25\ L} = 3.0\ M$

6. What is the total number of grams of NaOH (formula mass = 40. g/mol) needed to make 1.0 liter of a 0.20 molar solution?

   $1.0\ L \times \frac{0.20\ mol}{1\ L} \times \frac{40.\ g}{1\ mol} = 8.0\ g$

7. What is the number of moles of solute contained in 0.50 liter of 3.0 M HCl?

   $0.50\ L \times \frac{3.0\ mol}{1\ L} = 1.5\ mol$

8. How many grams of KOH are needed to prepare 250. milliliters of a 2.00 M solution of KOH (gram formula mass = 56.0 g/mol)?

   $0.250\ L \times \frac{2.00\ mol}{1\ L} \times \frac{56.\ g}{1\ mol} = 28\ g$

9. Which solution is the *most* concentrated? (Support your answer by calculating each molarity.)
   a. 0.1 mole of solute dissolved in 400 mL of solution = 0.1 mol / 0.4 L = 0.25 M
   b. 0.4 mole of solute dissolved in 100 mL of solution = 0.4 mol / 0.1 L = 4 M ← highest M
   c. 0.2 mole of solute dissolved in 300 mL of solution = 0.2 mol / 0.3 L = 0.67 M
   d. 0.3 mole of solute dissolved in 200 mL of solution = 0.3 mol / 0.2 L = 1.5 M