CONCENTRATION – a measure of the amount of substance per unit volume

For solutions, there are several expressions of concentration

g/mL	(Grams of Solute / 100 mL of solvent)	As is found with the graph on Reference Table G

Use Reference Table T to obtain the formulas for each of the following:

$$\text{Molarity (M)} = \frac{\text{Moles of Solute}}{\text{Liters of Solution}}$$

To determine the molarity of a solution:

1) Determine the number of moles of solute (given mass ÷G.F.M.)
2) Determine the volume of solution you have in liters (1000 mL = 1 L)
3) Solve.

$$\text{Parts Per Million (ppm)} = \frac{\text{Mass of Solute}}{\text{Mass of Solution}} \times 10^6$$

To determine the ppm of a solution:

1) Determine the mass (g) of solute only
2) Determine the mass (g) of solution
   - This is the solute + solvent together
3) Divide the two numbers, then multiply by 10^6.

$$\text{Percent Composition (\%)} = \frac{\text{Mass of Part}}{\text{Mass of Whole}} \times 100$$

This formula is used for Percent Mass and Percent Volume problems.

1) Determine the mass (g) of solute only
2) Determine the mass of solution (g)
   - This is the solute + solvent together
3) Divide the two numbers, then multiply by 100.

Dilutions are commonly needed when you need to make weaker strength solutions from a concentrated, stock solution. Quite often acids and solutions are purchased at high molarity concentrations, and to make a lower molarity solution you need to dilute a given amount with water.

$$\text{Dilutions} = M_1V_1 = M_2V_2$$

*as long as volume units are consistent on both sides, it can be mL or L

You will most commonly use this formula to determine what amount of the concentrated solution (example: 18 M HCl) you will need to make a more dilute solution (example: 500 mL at 6M)

M_1 = Molarity of the concentrated soln.
V_1 = volume of concentrated soln.
M_2 = Molarity of the desired weaker soln.
V_2= volume of the desired weaker soln.

Concentration Problems: Determine the formula necessary for each problem, show work necessary, and then solve for an answer with the correct number of significant figures.

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 4.01 g of NaOH. What is its molarity?

3. How many grams of KNO_3 are needed to prepare 250.0 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 parts per million of sulfur dioxide are there in a solution that contains 0.065 g of sulfur dioxide in 5,000. mL of water? (Assume density of water is 1 g/mL)

6. If 0.0020 g of $PbCl_2$ are dissolved in 2.00 L of water, how many parts per million are dissolved?

7. A solution is prepared by mixing 20.0 g of $NaNO_3$ with 100.0 mL of water. What is the percentage mass of the solution? (Assume density of water is 1 g/mL)

8. A 250. mL sample of air at STP contains approximately 52.5 mL of $O_2(g)$. What is the percentage of oxygen in air?

9. A polar solvent is prepared by mixing 27.5 mL of propanone with 222.5 mL of water. What is the percentage by volume of propanone in the mixture?

10. A 38.0% alcohol solution is made by dissolving 19.0 mL of alcohol in water. What was the volume of water used?

11. A 21.3% solution is prepared with KI and mixed in water. The mass of the total solution is 160. grams. What is the amount of KI solute that was dissolved in the water?

12. How many milliliters of a 12.0 M H_2SO_4 stock solution would need to be obtained to make 500. mL of a 1.25 M H_2SO_4 solution? _____How many milliliters of water would be needed? _____

13. If 100. mL of water is added to 250. mL of 6.0 M NaOH solution until the final volume of 350. mL, what will be the molarity of the diluted solution?