Concentration Calculations: Molarity Key

- First, copy the formulas for **molarity** and **number of moles** from your reference table:

Molarity = $\frac{\text{moles of solute}}{\text{L of solution}}$	Number of moles = $\frac{\text{given mass}}{\text{gram-formula mass}}$

- Use the formulas above to solve the following problems. As you work through each problem, remember these tips:
  - The amount of solute must be in moles to plug into the molarity formula. If it is given in grams, convert to moles using the "number of moles" formula.
  - The volume of solution must be in L to plug into the molarity formula. If it is given in mL, you must convert.
  - Once variables are in the correct units, write the formula, plug in values, and solve for x.

1. What is the molarity of a solution in which 58 g of NaCl are dissolved in 1.0 L of solution?

gfm = 58.5 g/mol
58 g → convert to moles

$\text{moles} = \frac{\text{mass}}{\text{gfm}} = \frac{58\text{ g}}{58.5\text{ g/mol}} = \boxed{0.99\text{ moles}}$

$M = \frac{\text{moles solute}}{\text{L of solution}} = \frac{0.99\text{ mol}}{1.00\text{ L}} = \boxed{0.99\text{ M}}$

2. What is the molarity of a solution in which 10.0 g of $AgNO_3$ is dissolved in 500 mL of solution?

gfm = 169.9 g/mol
10.0 g → convert to moles
500 mL → convert to L = .500 L

$\text{moles} = \frac{\text{mass}}{\text{gfm}} = \frac{10.0\text{ g}}{169.9\text{ g/mol}} = 0.0589\text{ mol}$

$M = \frac{\text{moles solute}}{\text{L of solution}} = \frac{0.0589\text{ mol}}{0.500\text{ L}} = \boxed{0.118\text{ M}}$

3. How many grams of KNO_3 should be used to prepare 2.00 L of a 0.500M solution?

gfm = 101.1 g/mol
find moles, then convert to grams

$M = \frac{\text{moles solute}}{\text{L solution}}$ $\quad 0.500\text{ M} = \frac{x}{2.00\text{ L}}$

$\boxed{1.00\text{ mol} = x}$

$\text{moles} = \frac{\text{mass}}{\text{gfm}}$ $\quad 1.00 = \frac{x}{101.1}$

$\boxed{x = 101.1\text{ g}}$

4. To what volume should 5.0 g of KCl be diluted in order to prepare a 0.25 M solution?

gfm = 74.6 g/mol
5.0 g → convert to moles

$\text{moles} = \frac{5.0\text{ g}}{74.6\text{ g/mol}} = 0.067\text{ mol}$

$0.25 = \frac{0.067\text{ mol}}{x}$

$\boxed{x = 0.268\text{ L}}$

Use the formulas for molarity and moles to complete the missing values in the table below.

$M = \frac{\text{moles}}{L}$ $\quad ML = \text{mol}$

Substance	Name	GFM	Grams of solute	Moles of solute $= \frac{g}{gfm}$	Volume of solution	Molarity $= \frac{\text{moles solute}}{\text{L solution}}$
$C_6H_{12}O_6$	glucose	180.0	75	$= \frac{75}{180} = 0.42$ mol	0.300 L	$= \frac{0.42 \text{ mol}}{0.300 \text{ L}} = 1.4$ M
NaCl	sodium chloride	58.5	100.	$= \frac{100.}{58.5} = 1.71$ mol	$L = \frac{\text{mol}}{M} = \frac{1.71 \text{ mol}}{8.00 M} = 0.214$ L	8.00
$MgCl_2$	magnesium chloride	95.3	= gfm x mol = 50.0 g	0.525	164 mL *convert to L 0.164 L	$= \frac{0.525 \text{ mol}}{0.164 \text{ L}} = 3.20$ M
HCl	hydrogen chloride	36.5	44.9 g	1.23	$L = \frac{1.23 \text{ mol}}{6.02 M} = 0.205$ L	6.00
NaOH	sodium hydroxide	40.0	15	0.375	$L = \frac{\text{mol}}{M} = \frac{0.375}{2.4} = 0.16$ L	2.4
$Fe(NO_3)_2$	iron (II) nitrate	179.8	75	$= \frac{75 g}{179.8 g/\text{mol}} =$ 0.42 mol	556 mL *convert to L 0.556 L	$= \frac{0.42 \text{ mol}}{0.556 \text{ L}} = 0.76$ M
$Fe(NO_3)_3$	iron (III) nitrate	241.8	= gfm x mol = 241.8 x .00025 = 0.060 g	mol = L x M = .000382 x .65 = .00025 mol	0.382ml = 0.000382 L	0.65

Work Space: (You may also use a piece of scrap paper for your work.)