

Molarity Worksheet

Definition

$$\text{Molar Concentration} = \frac{\text{amount of solute (mol)}}{\text{volume of solution (L)}}$$

Imagine 0.24 mol of CaF_2 are present in 1.9 L of solution, then the molar concentration of CaF_2 is:

$$\begin{aligned} [\text{CaF}_2] &= \frac{0.24 \text{ mol CaF}_2}{1.9 \text{ L}} \\ &= 0.13 \frac{\text{mol}}{\text{L}} \text{ CaF}_2 \\ &= 0.13 \text{ M CaF}_2 \end{aligned}$$

Where $[X]$ means the molar concentration (or molarity) of X and M is an abbreviation meaning mol/L.

Conversion-Factor

It is convenient to think of molar concentration as a conversion factor. If we have a solution that's 12.0 M HCl(aq) —then that means:

$$[\text{HCl}] = \frac{12.0 \text{ mol HCl}}{1 \text{ L}}$$

$$12.0 \text{ mol HCl} = 1 \text{ L}$$

and the two conversion factors are:

$$\frac{12.0 \text{ mol HCl}}{1 \text{ L}} \quad \text{or} \quad \frac{1 \text{ L}}{12.0 \text{ mol HCl}}$$

If we had 0.21 L of this solution, then it would contain:

$$0.21 \text{ L} \times \frac{12.0 \text{ mol HCl}}{1 \text{ L}} = 2.5 \text{ mol HCl}$$

Or if we wanted 1.09 mol of HCl, then we would have to measure out:

$$1.09 \text{ mol HCl} \times \frac{1 \text{ L}}{12.0 \text{ mol HCl}} = 0.0908 \text{ L}$$

We typically measure volume in mL in lab, and if you remember that there are 1000 mL in 1 L, we can make the following kinds of conversions:

25.0 mL of this solution contains:

$$25.0 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{12.0 \text{ mol HCl}}{1 \text{ L}} = 0.300 \text{ mol HCl}$$

And if we wanted to know what volume in milliliters would contain 0.100 mol HCl:

$$0.100 \text{ mol HCl} \times \frac{1 \text{ L}}{12.0 \text{ mol HCl}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 8.33 \text{ mL}$$

Problems to try

1. Write out the two conversion factors for the following solutions:

a. 1.8 mol/L $\text{HNO}_3(\text{aq})$

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b. 0.25 M $\text{NaOH}(\text{aq})$

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c. 18.0 M $\text{H}_2\text{SO}_4(\text{aq})$

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2. How many moles of solute are present in the following samples:

a. 0.29 L of 1.8 mol/L $\text{HNO}_3(\text{aq})$

b. 423 mL of 0.25 M $\text{NaOH}(\text{aq})$

c. 12.4 mL of 18.0 M $\text{H}_2\text{SO}_4(\text{aq})$

3. What volume of solution (in both L and mL) contains the following amounts of solute?

a. 0.30 mol HNO_3 , given 1.8 mol/L $\text{HNO}_3(\text{aq})$

b. 0.93 mol NaOH , given 0.25 M $\text{NaOH}(\text{aq})$

c. 2.90 mol H_2SO_4 , given 18.0 M $\text{H}_2\text{SO}_4(\text{aq})$

