

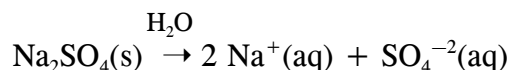
A

Molarity of Ions in Solution

Often it is necessary to calculate not only the concentration (in molarity) of a compound in aqueous solution but also the concentration of each ion in aqueous solution. The coefficients from the balanced dissolution equation are used in this type of calculation.

EXAMPLE: Calculate the concentrations of Na^+ and SO_4^{-2} in an aqueous solution of 2.0 M Na_2SO_4 .

Step 1: Write the balanced dissolution equation (i.e. equation showing how the strong electrolyte dissolves in water).



Step 2: Use the coefficients from the balanced dissolution equation to calculate the concentration of each ion in aqueous solution.

Molarity of Na^+ :

$$\frac{2.0 \text{ mol Na}_2\text{SO}_4}{1 \text{ L soln}} \times \frac{2 \text{ mol Na}^+}{1 \text{ mol Na}_2\text{SO}_4} = \frac{4.0 \text{ mol Na}^+}{\text{L soln}} \text{ OR } 4.0 \text{ M Na}^+$$

\uparrow molarity of soln \uparrow coefficients from the balanced dissolution eqn.

Molarity of SO_4^{-2} :

$$\frac{2.0 \text{ mol Na}_2\text{SO}_4}{1 \text{ L soln}} \times \frac{1 \text{ mol SO}_4^{-2}}{1 \text{ mol Na}_2\text{SO}_4} = \frac{2.0 \text{ mol SO}_4^{-2}}{\text{L soln}} \text{ OR } 2.0 \text{ M SO}_4^{-2}$$

\uparrow molarity of soln \uparrow coefficients from the balanced dissolution eqn.

Questions:

1. A 0.25 M aqueous solution of CaI_2 is _____ M in Ca^{+2} and _____ M in I^- .
2. A 0.75 M aqueous solution of $\text{Fe}(\text{ClO}_4)_3$ is _____ M in Fe^{+3} and _____ M in ClO_4^- .

Appendix A Molarity of Ions in Solution

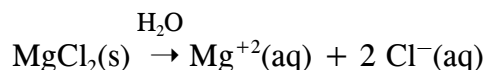
3. A 2.5 M aqueous solution of $\text{Fe}_2(\text{SO}_4)_3$ is _____ M in Fe^{+3} and _____ M in SO_4^{-2} .
4. An aqueous solution of $\text{Al}_2(\text{SO}_4)_3$ is 0.36 M in SO_4^{-2} . Calculate the concentration (in M) of $\text{Al}_2(\text{SO}_4)_3$ in this solution.

EXAMPLE: Calculate the concentrations of Mg^{+2} and Cl^- in an aqueous solution prepared by dissolving 19 g MgCl_2 in enough water to prepare 250. mL of solution.

Step 1: Calculate the molarity of the MgCl_2 solution.

$$\frac{19 \text{ g MgCl}_2}{250 \text{ mL soln}} \times \frac{1 \text{ mol MgCl}_2}{95.21 \text{ g MgCl}_2} \times \frac{1000 \text{ mL soln}}{1 \text{ L soln}} = \mathbf{0.80 \text{ M MgCl}_2}$$

Step 2: Write the balanced dissolution equation (i.e. equation showing how the strong electrolyte dissolves in water).



Step 3: Use the coefficients from the balanced dissolution equation to calculate the concentration of each ion in aqueous solution.

Molarity of Mg^{+2} :

$$\frac{0.80 \text{ mol MgCl}_2}{1 \text{ L soln}} \times \frac{1 \text{ mol Mg}^{+2}}{1 \text{ mol MgCl}_2} = \frac{0.80 \text{ mol Mg}^{+2}}{1 \text{ L soln}} \text{ OR } \mathbf{0.80 \text{ M Mg}^{+2}}$$

↓
coefficients from the
balanced dissolution eqn.
↓

Molarity of Cl^- :

$$\frac{0.80 \text{ mol MgCl}_2}{1 \text{ L soln}} \times \frac{2 \text{ mol Cl}^-}{1 \text{ mol MgCl}_2} = \frac{1.6 \text{ mol Cl}^-}{1 \text{ L soln}} \text{ OR } \mathbf{1.6 \text{ M Cl}^-}$$

Questions:

1. Calculate the concentrations of K^+ and NO_3^- in an aqueous solution prepared by dissolving 30.3 g KNO_3 in enough water to make 300. mL of solution.
2. Calculate the concentrations of Al^{+3} and SO_4^{-2} in an aqueous solution prepared by dissolving 17.1 g $\text{Al}_2(\text{SO}_4)_3$ in enough water to make 400. mL of solution.
3. Calculate the concentrations of Na^+ and SO_4^{-2} in an aqueous solution prepared by dissolving 852 g Na_2SO_4 in enough water to make 4.00 L of solution.
4. What mass (in g) of CaCl_2 is needed to prepare 100. mL of an aqueous solution that is 0.25 M in Cl^- ?
5. If 100. mL of 18.0 M H_2SO_4 solution are diluted to 10.0 L, what are the concentrations of H^+ and SO_4^{-2} in the diluted solution?

