Name: Key
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Chemistry 11
Lesson #5 Calculating the concentrations of IONS in solutions

**Recall:**

1. STOICHIOMETRY requires a balanced equation and in lesson #3 we learned about dissociation / ionization equations.
2. The Molarity formula: mol / M L  $M = mol \div L$
3. The Dilution formula: $M_iV_i = M_FV_F$ → $M_F = \frac{M_iV_i}{V_F}$

**Example 1**: What is the molar concentration for the **chloride ion** in 0.25 M $AlCl_3$ ?

i. Write out the Dissociation Equation:

$$1AlCl_{3\,(aq)} \rightarrow 1Al^{3+}{}_{(aq)} + 3Cl^-{}_{(aq)}$$

ii. Use the equation to cross the MOLEDENGATE bridge to solve for the individual ion

$$0.25M \therefore \frac{0.25 \text{ mol } AlCl_3}{1L} \times \frac{3 \text{ mol } Cl^-}{1 \text{ mol } AlCl_3} = 0.75\text{ M } Cl^-$$

**Example 2**. What is the molar concentration (molarity) of EACH ION that is made when mixing 50.0 mL of 0.500 M $AlCl_3$ with 75.0 mL of 0.200 M $NiF_2$ ?

i. Write out the Dissociation Equations:

$$1AlCl_{3\,(aq)} \rightarrow 1Al^{3+}{}_{(aq)} + 3Cl^-{}_{(aq)}$$
$$1NiF_{2\,(aq)} \rightarrow 1Ni^{2+}{}_{(aq)} + 2F^-{}_{(aq)}$$

ii. Use the Dilution formula TWICE to solve for the resulting concentrations of each compound:

$$[AlCl_3]_F = \frac{0.500M \cdot 0.0500L}{(0.0500L + 0.0750L)} \quad (= 0.1250L)$$
$$= 0.200M\ AlCl_3$$

$$[NiF_2]_F = \frac{0.200M \cdot 0.0750L}{0.1250L} = 0.120M\ NiF_2$$

iii. Use the equation to cross the MOLEDENGATE bridge to solve for the individual ions:

$$[Al^{3+}] = \frac{0.200 \text{ mol } AlCl_3}{1L} \times \frac{1 \text{ mol } Al^{3+}}{1 \text{ mol } AlCl_3} = 0.200\text{ M } Al^{3+}$$

$$[Cl^-] = \frac{0.200 \text{ mol } AlCl_3}{1L} \times \frac{3 \text{ mol } Cl^-}{1 \text{ mol } AlCl_3} = 0.600\text{ M } Cl^-$$

$$[Ni^{2+}] = 0.120\text{ M } Ni^{2+}$$

$$[F^-] = \frac{0.120 \text{ mol } NiF_2}{1L} \times \frac{2 \text{ mol } F^-}{1 \text{ mol } NiF_2} = 0.240\text{ M } F^-$$

**Example 3**. What is the molar concentration of each ion that is made by mixing 50.0 mL of 0.240 M $AlBr_3$ with 25.0 mL of 0.300 M $CaBr_2$?

i. Write out the Dissociation Equations:

$$1AlBr_3(aq) \rightarrow 1Al^{3+}(aq) + 3Br^-(aq)$$
$$1CaBr_2(aq) \rightarrow 1Ca^{2+}(aq) + 2Br^-(aq)$$

ii. Use the Dilution formula TWICE to solve for the resulting concentrations of each compound:

$$[AlBr_3]_F = \frac{0.240M \cdot 0.0500L}{0.0750L} = 0.160M\ AlBr_3$$

$$[CaBr_2]_F = \frac{0.300M \cdot 0.0250L}{0.0750L} = 0.100M\ CaBr_2$$

iii. Use the equation to cross the MOLEDENGATE bridge to solve for the individual ions:

$$[Al^{3+}] = \boxed{0.160M\ Al^{3+}} \qquad [Ca^{2+}] = \boxed{0.100M\ Ca^{2+}}$$

$$[Br^-]_I = \frac{0.160\,mol\ AlBr_3}{1L} \times \frac{3\,mol\ Br^-}{1\,mol\ AlBr_3} = 0.480M\ Br^-$$

$$[Br^-]_{II} = \frac{0.100\,mol\ CaBr_2}{1L} \times \frac{2\,mol\ Br^-}{1\,mol\ CaBr_2} = 0.200M\ Br^-$$

iv. Because you have TWO of the SAME ION you must add those two values together to get the FINAL CONCENTRAION:

| | |
|---|---|
| 0.480 | $M\ Br^-$ |
| 0.200 | $M\ Br^-$ |
| **0.680** | **$M\ Br^-$** |

ionization eqn

$Br^-$ ~~$Br_2$~~

dissociation

charges (product)

**Seatwork/Homework:** Ex 30-38 pages 210-212