Advanced Solution Calculations

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example #1 : 400mL of 0.250M $Al(NO_3)_3$, 500mL of 0.200 M $Ca(NO_3)_2$ and 1000mL of 0.200M $NaNO_3$ are mixed together.

What is the $[NO_3^-]$ you would expect. Assume volumes are additive.

$$Al(NO_3)_3(s) \rightarrow Al^{3+} + 3NO_3^{1-}$$

$$\rightarrow 400mL \times \frac{1L}{1000mL} \times \frac{0.250mol\ Al(NO_3)_3}{1L} \times \frac{3\ mol\ NO_3^{1-}}{1\ mol\ Al(NO_3)_3} = 0.300mol\ NO_3^{1-}$$

$$Ca(NO_3)_2(s) \rightarrow Ca^{2+} + 2NO_3^{1-}$$

$$\rightarrow 500mL \times \frac{1L}{1000mL} \times \frac{0.200mol\ Ca(NO_3)_2}{1L} \times \frac{2\ mol\ NO_3^{1-}}{1\ mol\ Ca(NO_3)_2} = 0.200mol\ NO_3^{1-}$$

$$NaNO_3(s) \rightarrow Na^{1+} + NO_3^{1-}$$

$$\rightarrow 1000mL \times \frac{1L}{1000mL} \times \frac{0.200mol\ NaNO_3}{1L} \times \frac{1\ mol\ NO_3^{1-}}{1\ mol\ NaNO_3} = 0.200mol\ NO_3^{1-}$$

$$n_T^{NO_3^{1-}} = n_{Al(NO_3)_3}^{NO_3^{1-}} + n_{Ca(NO_3)_2}^{NO_3^{1-}} + n_{NaNO_3}^{NO_3^{1-}}$$

$$= 0.300mol\ NO_3^{1-} + 0.200mol\ NO_3^{1-} + 0.200mol\ NO_3^{1-}$$

$$= 0.700mol\ NO_3^{1-}$$

$$V_T = V_{Al(NO_3)^2} + V_{Ca(NO_3)_2} + V_{Na(NO_3)}$$

$$= 400mL + 500mL + 1000mL$$

$$= 1900mL$$

$$= 1.900L$$

$n = 0.700mol\ NO_3^{1-}$

$C = ?$

$V = 1.900L$

$$C = \frac{n}{V}$$

$$= \frac{0.700mol\ NO_3^{1-}}{1.900L}$$

$$= 0.368\ mol/L$$

$$\therefore [NO_3^{1-}] = 0.368M$$

Reminder : p.p.m

p.p.m is $\frac{mg}{L}$

↳ can be used as a conversion factor

example #2 :

What volume of bottled water would you need to drink in order to obtain 0.5g Ca^{2+} give the $[Ca^{2+}]$ is 100 p.p.m

$$0.5\,g\,Ca^{2+} \times \frac{1000\,mg}{1\,g} \times \frac{1\,L}{100\,mg\,Ca^{2+}} \times \frac{1000\,mL}{1\,L} = 5000\,mL$$

example #3 :

2.5L of water is found to contain 0.088 mol Na^{1+}. What is the concentration of Na^{1+} in p.p.m.

$$\frac{0.088\,mol\,Na^{1+}}{2.5\,L} \times \frac{22.99\,g\,Na^{1+}}{1\,mol\,Na^{1+}} \times \frac{1000\,mg}{1\,g} \quad \frac{809\,mg\,Na^{1+}}{1\,L}$$

$\therefore [Na^{1+}] = 809$ p.p.m

example #4 :

500mL of solution is found to contain 5.2mmol of Ag^{1+}. Find p.p.m.

$$\frac{5.2\,mmol\,Ag^{1+}}{500\,mL} \times \frac{1\,mol}{1000\,mmol} \times \frac{107.87\,g\,Ag^{1+}}{1\,mol\,Ag^{1+}} \times \frac{1000\,mg}{1\,g} \times \frac{1000\,mL}{1\,L} = \frac{1121\,mg\,Al^{1+}}{1\,L}$$

$\therefore [Ag^{1+}] = 1121$ p.p.m Ag^{1+}