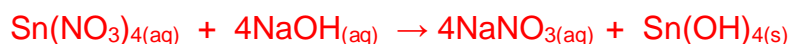


## Stoichiometry and Solutions

Using the formula  $n = cV$ , calculations involving chemical reactions with solutions can be performed.

For example: Calculate the mass of tin (IV) hydroxide produced when  $3.45 \times 10^{-1}$  L of  $1.982 \times 10^1$  mol L<sup>-1</sup> tin (IV) nitrate reacts with excess sodium hydroxide solution.

$$n_{\text{Sn}(\text{NO}_3)_4} = cV = (1.982 \times 10)(3.45 \times 10^{-1}) = 6.8379 \text{ mol}$$



OR



$$n_{\text{Sn}(\text{OH})_4} = n_{\text{Sn}(\text{NO}_3)_4} = 6.8379 \text{ mol}$$

$$m_{\text{Sn}(\text{OH})_4} = nM = (6.8379)(186.732) = 1.28 \times 10^3 \text{ g}$$

Using **all the formulae** we have learnt throughout the year, it is now possible to perform stoichiometric calculations for chemical equations using solids, liquids, gases and solutions.

For example; calculate the volume of carbon dioxide gas produced at STP when 896 mL of  $6.09 \times 10^{-2}$  mol L<sup>-1</sup> nitric acid reacts with 3.44 g of solid calcium carbonate.



$$\begin{aligned} n_{\text{HNO}_3} &= cV \\ &= (6.09 \times 10^{-2})(896 \times 10^{-3}) \\ &= 0.054566 \text{ mol} \end{aligned}$$

$$\begin{aligned} n_{\text{CaCO}_3} &= m/M \\ &= 3.44 / 100.09 \\ &= 0.034369 \text{ mol} \end{aligned}$$

$$\begin{aligned} &0.054566 / 2 \\ &= 0.0272832 \end{aligned}$$

$$\begin{aligned} &0.034369 / 1 \\ &= 0.034369 \end{aligned}$$

$\text{HNO}_3$  is limiting reagent as there is less of it on a mole to mole basis.

$$\begin{aligned} n_{\text{CO}_2} &= n_{\text{HNO}_3} \times \frac{1}{2} \\ &= (0.054566) \left(\frac{1}{2}\right) \\ &= 0.0272832 \text{ mol} \end{aligned}$$

$$\begin{aligned} V_{\text{CO}_2} &= n \times 22.71 \\ &= (0.0272832)(22.71) \\ &= 0.61960 \\ &= 0.620 \text{ L} \end{aligned}$$