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 3.45×10^{-1} L of 1.982×10^{1} mol L^{-1} tin (IV) nitrate reacts with excess sodium hydroxide solution.

$n_{Sn(NO_3)4}$ = cV = (1.982 x 10)(3.45 x10^{-1}) = 6.8379mol

$$Sn(NO_3)_{4(aq)} + 4NaOH_{(aq)} \rightarrow 4NaNO_{3(aq)} + Sn(OH)_{4(s)}$$

OR

$$Sn^{4+}_{(aq)} + 4OH^{-}_{(aq)} \rightarrow Sn(OH)_{4(s)}$$

$n_{Sn(OH)4} = n_{Sn(NO_3)4}$ = 6.8379 mol

$m_{Sn(OH)4}$ = nM = (6.8379)(186.732) = 1.28 x 10^{3} 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 6.09×10^{-2} mol L^{-1} nitric acid reacts with 3.44 g of solid calcium carbonate.

$$2HNO_3 + CaCO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$$

n_{HNO3} = cV
= (6.09×10^{-2}) (896 x 10^{-3})
= 0.054566 mol

0.054566 / 2
= 0.0272832

n_{CaCO3} = m/M
= 3.44/ 100.09
= 0.034369 mol

0.034369 / 1
= 0.034369

HNO_3 is limiting reagent as there is less of it on a mole to mole basis.

n_{CO2} = n_{HNO3} x ½
= (0.054566) (½)
= 0.0272832 mol

V_{CO2} = n x 22.71
= (0.0272832) (22.71)
= 0.61960
= 0.620 L