5. Calculating the concentration/number of moles and volume using the formula:

Concentration = No. of moles ÷ Volume

Unit: mole/dm^3

Example: **[O/N/2010-P31-Q8b]**

(b) 6.0 g of cobalt(II) carbonate was added to 40 cm^3 of hydrochloric acid, concentration 2.0 mol/dm^3. Calculate the maximum yield of cobalt(II) chloride-6-water and show that the cobalt(II) carbonate was in excess.

$$CoCO_3 + 2HCl \rightarrow CoCl_2 + CO_2 + H_2O$$

$$CoCl_2 + 6H_2O \rightarrow CoCl_2.6H_2O$$

Maximum yield

Number of moles of HCl used = ...

Number of moles of $CoCl_2$ formed = ...

Number of moles of $CoCl_2.6H_2O$ formed = ...

Solution:

Ideal Mole ratio:[Equation 1]

$CaCO_3$	:	HCl	:	$CoCl_2$	:	CO_2	:	H_2O
1	:	2	:	1	:	1	:	1- Ideal mole ratio
0.040	:	0.080	:	0.040	:	0.040	:	0.040-Experimental mole ratio

Moles of HCl= Concentration of HCl x Volume of HCl

=2 x 0.040 =0.080

Comparing with the ideal mole ratio ;

Moles of $CoCl_2$ formed = 0.5 x moles of HCl

= 0.5 x 0.080 = 0.040

Also;

Ideal Mole ratio:[Equation 1]

$CoCl_2$	:	H_2O	:	$CoCl_2.6\ H_2O$
1	:	6	:	1
0.040	:	0.24	:	0.040-Experimental mole ratio

Hence;

Moles of $CoCl_2.6\ H_2O$ formed = Moles of $CoCl_2$ used = 0.040

Note: The underlined mole ratio is the data we obtain after calculations.
