CALCULATING VOLUME

1 Chlorine, bromine and iodine are halogens.

(a) Chlorine can be made in the laboratory by heating manganese(IV) oxide with concentrated hydrochloric acid.

$$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$$

Calculate the volume of 8.00 mol / dm^3 $HCl(aq)$ needed to react with 3.48 g of MnO_2.

- moles of MnO_2 used

..... mol

- moles of HCl needed

..... mol

- volume of HCl needed

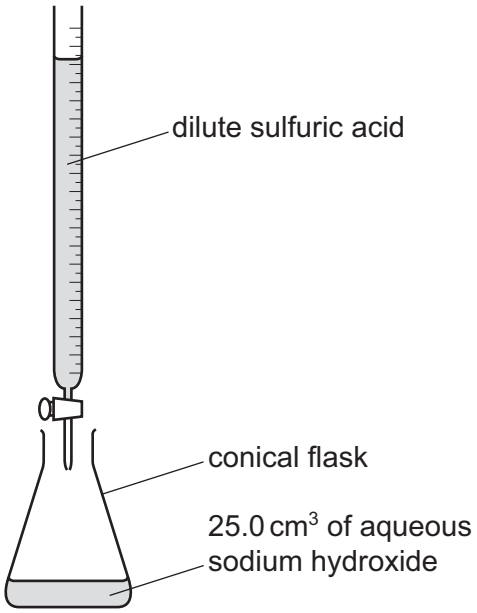
..... cm^3

[4]

MARKING SCHEME:

(a)	$20\,cm^3$ **M1** M_r of MnO_2: 87 **M2** moles of MnO_2 used: 3.48 / 87 = 0.04 **M3** moles of HC*l* needed: 0.04 × 4 = 0.16 **M4** volume of HC*l* needed: (0.16 / 8.0) × 1000 **AND** $20\,cm^3$	4

2 Dilute sulfuric acid and aqueous sodium hydroxide are used to make aqueous sodium sulfate, $Na_2SO_4(aq)$, or aqueous sodium hydrogen sulfate, $NaHSO_4(aq)$. The method includes use of the following apparatus.



25.0 cm^3 of aqueous sodium hydroxide of concentration 0.100 mol/dm^3 was neutralised by 25.0 cm^3 of dilute sulfuric acid of concentration 0.0500 mol/dm^3. The equation for the reaction is shown. This is **reaction 1**.

$$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l) \qquad \textbf{reaction 1}$$

The same technique and the same solutions can be used to make aqueous sodium hydrogen sulfate. The equation for the reaction is shown. This is **reaction 2**.

$$NaOH(aq) + H_2SO_4(aq) \rightarrow NaHSO_4(aq) + H_2O(l) \qquad \textbf{reaction 2}$$

Complete the table to calculate the volume of dilute sulfuric acid that reacts with 25.0 cm^3 of aqueous sodium hydroxide in **reaction 2**.

	volume of 0.0500 mol/dm^3 dilute sulfuric acid in cm^3	volume of 0.100 mol/dm^3 aqueous sodium hydroxide in cm^3
reaction 1	25.0	25.0
reaction 2		25.0

[1]

MARKING SCHEME:

	50.0 (cm^3)	**1**