EXTRA LAB # 2

Quantitative analysis

Read through the whole method before starting any practical work. Where appropriate, prepare a table for your results in the space provided.

Show your working and appropriate significant figures in the final answer to **each** step of your calculations.

1 Group 1 metal carbonates have the formula $\mathbf{M}_2CO_3$. The identity of the metal ion, $\mathbf{M}^+$, may be determined by a gravimetric method. The metal carbonate is reacted with excess acid and the mass of carbon dioxide given off is measured.

$$\mathbf{M}_2CO_3(s) + 2HCl(aq) \rightarrow 2\mathbf{M}Cl(aq) + H_2O(l) + CO_2(g)$$

FA 1 is a Group 1 metal carbonate, $\mathbf{M}_2CO_3$.
FA 2 is 2.0 mol dm^{-3} hydrochloric acid, HCl.

(a) Method

- Use the 25 cm^3 measuring cylinder to transfer 25.0 cm^3 of **FA 2** into a conical flask. Weigh the flask with the acid and record the mass.
- Weigh the container with **FA 1** and record the mass.
- **Carefully** tip all of **FA 1** into the acid in the conical flask. Swirl the contents of the flask and leave the flask to stand.
- Weigh the container with any residual **FA 1**. Record the mass.
- Calculate and record the mass of **FA 1** added to the conical flask.
- Calculate and record the theoretical initial mass of flask + acid + **FA 1**.
- Swirl the flask occasionally while leaving it to stand for approximately 5 minutes.

- Weigh the flask and contents and record this mass.
- Calculate and record the mass of carbon dioxide given off during the experiment.

Results

mass of flask + acid/g	130.57
mass of container + FA1/g	22.47
mass of container + residue/g	21.06
mass of FA1 added/g	1.41
initial mass of flask + acid + FA1/g	131.98
mass of flask + acid + contents after reaction/g	131.20
mass of CO_2 given off/g	0.78

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[4]

(b) Calculations

(i) Calculate the number of moles of carbon dioxide given off in the experiment.

$n = \frac{m}{M_r} = \frac{0.78}{44}$

moles of CO_2 = 0.0177 mol [1]

(ii) Calculate the relative formula mass, M_r, of $\mathbf{M}_2CO_3$.

$M_2CO_3 : CO_2$

1 : 1

0.0177 mol

$M_r = \frac{m}{n} = \frac{1.41}{0.0177} = 79.7$

M_r of $\mathbf{M}_2CO_3$ = 79.7 [1]

(iii) Identify the Group 1 cation, $\mathbf{M}^+$, in **FA 1**.
Show your working.

$2M : M_2CO_3 - CO_3$

$2M = 79.7 - 60$

$M = \frac{19.7}{2} = 9.8$

$\mathbf{M}^+$ is Li^+ [1]

(c) One source of error in this experiment is the solubility of carbon dioxide in water.

(i) Suggest **one** modification, to the method in **(a)**, to reduce the solubility of carbon dioxide in the solution in the flask.

Use pre-heated acid to reduce solubility of CO_2 [1]

(ii) An assumption made in the method in **(a)** is that the acid is in excess.

Show by calculation that this assumption is true.

moles of HCl added

$n = cV$

$= 2.0 \times \frac{25.0}{1000}$

0.0500 mol

moles of HCl consumed

HCl : CO_2

2 : 1

x : 0.0177

0.0354 mol

Hence acid was in excess.

[2]

[Total: 10]