EXPERIMENT NO. 10

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 In this experiment you will determine the concentration of a sample of hydrochloric acid. You will do this by measuring the volume of hydrogen produced when an excess of magnesium reacts with the acid.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

FA 1 is magnesium powder, Mg.
FA 2 is hydrochloric acid, HCl.

(a) Method

- Weigh the container with **FA 1**. Record the mass.
- Fill the tub with water to a depth of approximately 5 cm.
- Fill the 250 cm^3 measuring cylinder completely with water. Hold a piece of paper towel firmly over the top, invert the measuring cylinder and place it in the water in the tub.
- Remove the paper towel and clamp the inverted measuring cylinder so that the open end is just above the base of the tub.
- Use the 25 cm^3 measuring cylinder to place 25.0 cm^3 of **FA 2** into the reaction flask, labelled **X**.
- Check that the bung fits tightly in the neck of flask **X**, clamp flask **X**, and place the end of the delivery tube into the inverted 250 cm^3 measuring cylinder.
- Remove the bung from the neck of flask **X**. Tip all of **FA 1** into flask **X** and replace the bung **immediately**. Remove the flask from the clamp and swirl to mix the contents.
- Swirl the flask occasionally until no more gas is evolved. Replace the flask in the clamp.
- Measure and record the final volume of gas in the measuring cylinder.
- Weigh and record the mass of the container with any residual solid.
- Calculate and record the mass of **FA 1** used.

mass of FA1 + container / g	20.75
mass of container + residue / g	20.44
mass of FA1 used / g	0.31
Volume of gas collected / cm^3	152

[2]

(b) Calculations

(i) Calculate the number of moles of hydrogen gas produced.
(Assume 1 mol of gas occupies 24.0 dm^3 at this temperature.)

$24\,dm^3$ — 1 mol
$\frac{152}{1000}$ — x

moles of $H_2(g)$ = ... 6.33×10^{-3} ..... mol
[1]

(ii) Calculate the concentration of hydrochloric acid in **FA 2**.

HCl : H_2
2 : 1
x = 6.33×10^{-3}
1.266×10^{-2} mol/25 cm^3

$C = \frac{n}{V}$
$= \frac{1.266 \times 10^{-2}}{25.0/1000}$

concentration of HCl in **FA 2** = ... 0.5064 ..... mol dm^{-3}
[1]

(iii) In this experiment the magnesium powder was in excess.

Calculate the mass of magnesium powder needed for complete reaction with all the hydrochloric acid in 25.0 cm^3 of **FA 2**.

Mg : HCl
1 : 2
x : 1.266×10^{-2}
6.33×10^{-3} mol

$m = n \times Ar$
$= 6.33 \times 10^{-3} \times 24.3$

mass of Mg = ... 0.1538 ..... g
[1]

(c) A student suggested two modifications to the method in **(a)** to give a more accurate value for the concentration.

For each suggestion, state whether you agree with the student and explain your answer.

Suggestion 1: Use magnesium ribbon rather than powdered magnesium; keep the rest of the experiment the same.

Agree, with magnesium ribbon reaction will be slow so bung can be easily placed on the conical flask.

Suggestion 2: Use twice the mass of magnesium powder; keep the rest of the experiment the same.

Disagree, as magnesium is already in the excess.

[2]

(d) Another student carried out the experiment in **(a)** but used less magnesium than that calculated in **(b)(iii)**.

State and explain the effect this would have on the calculated concentration of hydrochloric acid in **FA 2**.

Concentration of HCl will be lower because of low volume of gas so less number number of moles.

..... [1]

[Total: 8]