

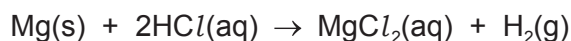
EXPERIMENT NO. 10

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.



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 cm³ 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 cm³ measuring cylinder to place 25.0 cm³ 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 cm³ 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 dm³ at this temperature.)

$$\frac{24 \text{ dm}^3}{152} \text{ --- } 1 \text{ mol}$$
$$\frac{152}{1000} \text{ --- } x$$

moles of H₂(g) = 6.33×10^{-3} mol [1]

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

$$\begin{array}{l} \text{HCl} : \text{H}_2 \\ 2 : 1 \\ x = 6.33 \times 10^{-3} \\ 1.266 \times 10^{-2} \text{ mol} / 25 \text{ cm}^3 \end{array} \quad \begin{array}{l} | \\ | \\ | \\ | \end{array} \quad \begin{array}{l} m = n \times A_r \\ = 6.33 \times 10^{-3} \times 24.3 \end{array}$$
$$C = \frac{n}{V} = \frac{1.266 \times 10^{-2}}{25.0/1000}$$

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 cm³ of **FA 2**.

$$\begin{array}{l} \text{Mg} : \text{HCl} \\ 1 : 2 \\ x = 1.266 \times 10^{-2} \\ 6.33 \times 10^{-3} \text{ mol} \end{array} \quad \begin{array}{l} | \\ | \\ | \\ | \end{array} \quad \begin{array}{l} m = n \times A_r \\ = 6.33 \times 10^{-3} \times 24.3 \end{array}$$

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.

- (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]