Stoichiometry

Question Paper 5
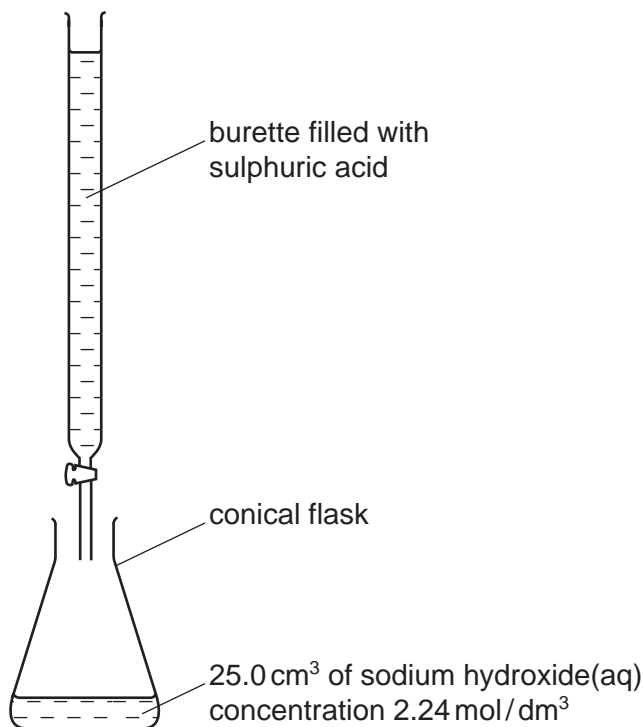
Level	IGCSE
Subject	Chemistry
ExamBoard	CIE
Topic	Stoichiometry
Sub-Topic	
Paper	(Extended) Theory
Booklet	Question Paper 5

TimeAllowed: **62 minutes**

Score: **/ 51**

Percentage: **/100**

1   Crystals of sodium sulphate-10-water, $Na_2SO_4.10H_2O$, are prepared by titration.

burette filled with
sulphuric acid

conical flask

$25.0\,cm^3$ of sodium hydroxide(aq)
concentration $2.24\,mol/dm^3$

(a) $25.0\,cm^3$ of aqueous sodium hydroxide is pipetted into a conical flask.
A few drops of an indicator are added. Using a burette, dilute sulphuric acid is slowly
added until the indicator just changes colour. The volume of acid needed to neutralise
the alkali is noted.

Suggest how you would continue the experiment to obtain pure, dry crystals of sodium
sulphate-10-water.

....

....

....

.... [4]

(b) Using $25.0\,cm^3$ of aqueous sodium hydroxide, $2.24\,mol/dm^3$, 3.86 g of crystals were
obtained. Calculate the percentage yield.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

$$Na_2SO_4 + 10H_2O \longrightarrow Na_2SO_4.10H_2O$$

Number of moles of NaOH used = ...

Maximum number of moles of $Na_2SO_4.10H_2O$ that could be formed = ...

Mass of one mole of $Na_2SO_4.10H_2O$ = 322 g

Maximum yield of sodium sulphate-10-water = ... g

Percentage yield = ... %   [4]

[Total: 8]

2 **(a (i)** Write a symbol equation for the action of heat on zinc hydroxide.

[2]

(ii) Describe what happens when solid **sodium** hydroxide is heated strongly.

[1]

(b) What would be **observed** when copper(II) nitrate is heated?

[3]

(c) Iron(III) sulphate decomposes when heated. Calculate the mass of iron(III) oxide formed and the volume of sulphur trioxide produced when 10.0 g of iron(III) sulphate was heated.
Mass of one mole of $Fe_2(SO_4)_3$ is 400 g.

$$Fe_2(SO_4)_3 \text{ (s)} \longrightarrow Fe_2O_3 \text{ (s)} + 3SO_3 \text{ (g)}$$

Number of moles of $Fe_2(SO_4)_3$ =

Number of moles of Fe_2O_3 formed =

Mass of iron(III) oxide formed =   g

Number of moles of SO_3 produced =

Volume of sulphur trioxide at r.t.p. = dm^3 [5]

3   Calcium and other minerals are essential for healthy teeth and bones. Tablets can be taken to provide these minerals.

Healthy Bones

Each tablet contains

calcium

magnesium

zinc

copper

boron

(a) Boron is a non-metal with a macromolecular structure.

  (i) What is the valency of boron?

  ....

  (ii) Predict **two** physical properties of boron.

  ....

  ....

  (iii) Name another element and a compound that have macromolecular structures.

  element …………………..

  compound ………………………

  (iv) Sketch the structure of one of the above macromolecular substances.

(b) Describe the reactions, if any, of zinc and copper(II) ions with an excess of aqueous sodium hydroxide.

   (i) zinc ions

   addition of aqueous sodium hydroxide ....

   ....

   excess sodium hydroxide ....

   ....

   (ii) copper(II) ions

   addition of aqueous sodium hydroxide ....

   ....

   excess sodium hydroxide ....

   ....[4]

(c) Each tablet contains the same number of moles of $CaCO_3$ and $MgCO_3$. One tablet reacted with excess hydrochloric acid to produce 0.24 dm^3 of carbon dioxide at r.t.p.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + {}_2O$$
$$MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + {}_2O$$
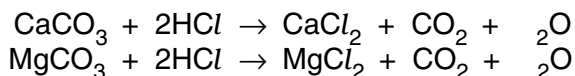
   (i) Calculate how many moles of $CaCO_3$ there are in one tablet.

   number of moles CO_2 = ...

   number of moles of $CaCO_3$ and $MgCO_3$ = ...

   number of moles of $CaCO_3$ = ...
                                                                                                   [3]

   (ii) Calculate the volume of hydrochloric acid, 1.0 mol / dm^3, needed to react with one tablet.

   number of moles of $CaCO_3$ and $MgCO_3$ in one tablet   = ...
   Use your answer to **(c)(i)**.

   number of moles of HCl needed to react with one tablet = ...

   volume of hydrochloric acid, 1.0 mol / dm^3, needed to
   react with one tablet   = ...
                                                                                                   [2]

4 Sulphur dioxide, SO_2, and sulphur trioxide, SO_3, are the two oxides of sulphur.

(a) Sulphur dioxide can kill bacteria and has bleaching properties. Give a use of sulphur dioxide that depends on each of these properties.

(i) ability to kill bacteria ....[1]

(ii) bleaching properties ....[1]

(b) Sulphur trioxide can be made from sulphur dioxide.

(i) Why is this reaction important industrially?

....[1]

(ii) Complete the word equation.

sulphur dioxide + ……………….…………………… $\longrightarrow$ sulphur trioxide [1]

(iii) What are the conditions for this reaction?

....

....[2]

(c) Sulphur dioxide is easily oxidised in the presence of water.

$$SO_2 + 2H_2O - 2e^- \longrightarrow SO_4^{2-} + 4H^+$$
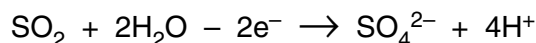
(i) What colour change would be observed when an excess of aqueous sulphur dioxide is added to an acidic solution of potassium manganate(VII)?

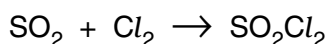...[2]

(ii) To aqueous sulphur dioxide, acidified barium chloride solution is added. The mixture remains clear. When bromine is added, a thick white precipitate forms. What is the white precipitate? Explain why it forms.

....

....[3]

(d) Sulphur dioxide reacts with chlorine in an addition reaction to form sulphuryl chloride.

$$SO_2 + Cl_2 \longrightarrow SO_2Cl_2$$

8.0 g of sulphur dioxide was mixed with 14.2 g of chlorine. The mass of one mole of SO_2Cl_2 is 135 g.

Calculate the mass of sulphuryl chloride formed by this mixture.

Calculate the number of moles of SO_2 in the mixture = ………………

Calculate the number of moles of Cl_2 in the mixture = ………………

Which reagent was not in excess? …………………………

How many moles of SO_2Cl_2 were formed = ………………..

Calculate the mass of sulphuryl chloride formed = …………. g [5]