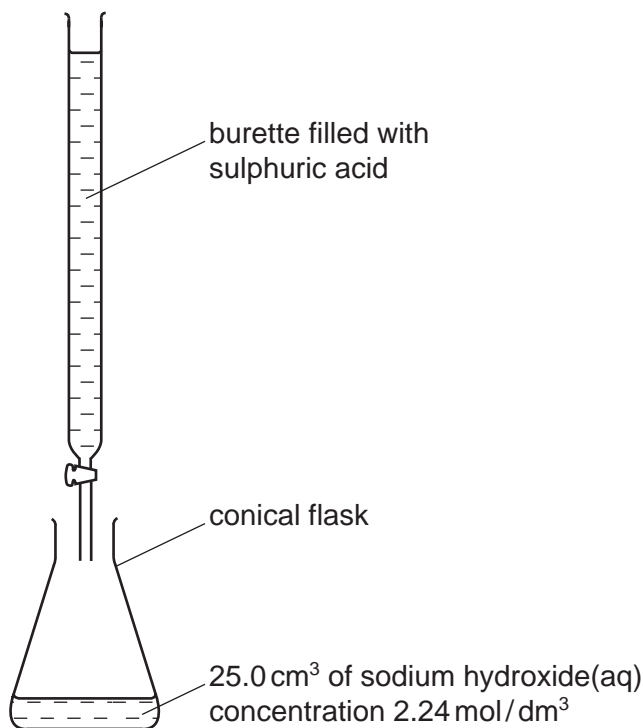


1 Crystals of sodium sulphate-10-water, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$, are prepared by titration.



- (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.

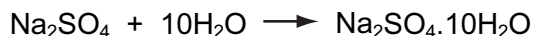
.....

.....

.....

[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.



Number of moles of NaOH used =

Maximum number of moles of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ that could be formed =

Mass of one mole of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O} = 322 \text{ g}$

Maximum yield of sodium sulphate-10-water = g

Percentage yield = % [4]

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 $\text{Fe}_2(\text{SO}_4)_3$ is 400 g.



Number of moles of $\text{Fe}_2(\text{SO}_4)_3$ =	
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

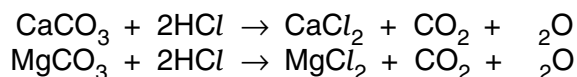
addition of aqueous sodium hydroxide

.....

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.



(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, SO₂, and sulphur trioxide, SO₃, 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]

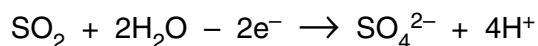
(ii) Complete the word equation.

sulphur dioxide + → sulphur trioxide [1]

(iii) What are the conditions for this reaction?

.....
.....[2]

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



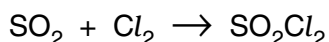
(i) What colour change would be observed when an excess of aqueous sulphur dioxide is added to an acidic solution of potassium manganate(VII)?

.....[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.



8.0 g of sulphur dioxide was mixed with 14.2 g of chlorine. The mass of one mole of SO₂Cl₂ is 135 g.

Calculate the mass of sulphuryl chloride formed by this mixture.

Calculate the number of moles of SO₂ in the mixture =

Calculate the number of moles of Cl₂ in the mixture =

Which reagent was not in excess?

How many moles of SO₂Cl₂ were formed =