



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2025

Centre Number

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Candidate Number

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Chemistry

Assessment Unit AS 1

assessing

Basic concepts in Physical
and Inorganic Chemistry



SCH14

[SCH14]

TUESDAY 13 MAY, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

In **Section A**, answer each question by circling the appropriate letter below the question.

In **Section B**, you must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete questions in black ink and use a dark HB pencil for drawings and graphs.

Do not write with a gel pen.

Answer **all fifteen** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

You may use a scientific calculator.

Quality of written communication will be assessed in Question **13(b)(iii)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

14551



20SCH1401

Section B

Answer **all five** questions in this section.

11 (a) Complete the following table.

Name	Formula
sodium thiosulfate	
	$\text{Ca}_3(\text{PO}_4)_2$
potassium nitrite	
	$(\text{NH}_4)_2\text{CrO}_4$

[4]

(b) Chromium(III) sulfate is used in tanning leather. It is soluble in water. At high temperatures it decomposes to give chromium(III) oxide, sulfur dioxide and oxygen.

(i) Write an equation for this decomposition reaction.

_____ [2]

(ii) Describe a test to confirm the presence of sulfate ions in a sample of solid chromium(III) sulfate.

_____ [3]

(iii) What is the systematic name for sulfur dioxide?

_____ [1]



(iv) Describe the test for oxygen gas.

[1]

14551

[Turn over



20SCH1407

12 The halogens are in Group VII of the Periodic Table. The first ionisation energy of the elements decreases down the group.

(a) Write an equation which represents the first ionisation energy of chlorine.

_____ [1]

(b) Explain the trend in first ionisation energy of the elements down Group VII.

_____ [2]

(c) The boiling points of the elements increase down Group VII. Explain this trend in boiling point.

_____ [2]



(d) The trend in oxidising ability of the halogens can be determined by mixing aqueous solutions of halogens with aqueous solutions of potassium halide salts.

(i) Complete the following table, using a tick (✓) or a cross (X), to indicate whether a reaction occurs or not. One row has been completed for you.

potassium halide \ halogen	potassium chloride	potassium bromide	potassium iodide
chlorine		✓	✓
bromine			
iodine			

[1]

(ii) State the colour change observed in the solution when aqueous chlorine is added to potassium bromide solution.

From _____ to _____ [1]

(iii) Write the ionic equation for the reaction between chlorine and potassium bromide.

_____ [1]

(iv) Silver nitrate solution and dilute ammonia solution can be used to identify and confirm the presence of halide ions in solution. Describe how both solutions can be used to confirm that no bromide ions remain in the solution when the reaction in (d)(iii) is complete.

_____ [3]

[Turn over



(e) Solid sodium chloride and solid sodium bromide react with concentrated phosphoric acid and both reactions give the same observation. However, concentrated sulfuric acid can be used to distinguish between the two solid halides.

(i) State the observation made when concentrated phosphoric acid is added separately to solid sodium chloride and to solid sodium bromide.

_____ [1]

(ii) State the observation which can be used to distinguish between the two halides when concentrated sulfuric acid is added separately to solid sodium chloride and to solid sodium bromide.

_____ [1]

(iii) Name all the products formed when concentrated sulfuric acid reacts with solid sodium bromide.

_____ [3]

(iv) Explain why more products form in the reaction between concentrated sulfuric acid and solid sodium bromide than in the reaction between concentrated sulfuric acid and solid sodium chloride.

_____ [1]



- (f) The concentration of a solution of sodium bromide is 6.5 mg in 100 cm³ of water. Calculate the molarity of the sodium bromide solution. Give your answer to 2 significant figures.

Answer _____ M [3]



13 (a) Chlorine trifluoride, ClF_3 , is an extremely reactive interhalogen compound used in the semiconductor industry.

(i) Suggest the meaning of the term 'interhalogen' compound.

_____ [1]

(ii) What is the oxidation number of chlorine in chlorine trifluoride?

_____ [1]

(iii) Draw a dot and cross diagram to show the bonding in a molecule of chlorine trifluoride. Show outer electrons only.

[1]

(b) Chlorine trifluoride reacts with ammonia to form nitrogen, chlorine and hydrogen fluoride.

(i) Write an equation for this reaction.

_____ [2]

(ii) Draw the shape of a molecule of ammonia.

[1]



- (iii) A molecule of ammonia can gain a hydrogen ion to form an ammonium ion, NH_4^+ , or it can lose a hydrogen ion to form an azanide ion, NH_2^- .

State and explain the shape of an ammonium ion and the shape of an azanide ion. Include in your answer the approximate bond angles.

In this question you will be assessed on the quality of your written communication skills, including the use of specialist scientific terms.

ammonium ion, NH_4^+

azanide ion, NH_2^-

[6]

[Turn over

14551



20SCH1413

14 Sulfur reacts with metals and with non-metals.

(a) Sulfur reacts with hydrogen to form hydrogen sulfide. Hydrogen sulfide can be oxidised to sulfur by nitric acid.

(i) State the observation which would indicate the presence of hydrogen sulfide.

_____ [1]

(ii) Hydrogen sulfide and water are Group VI hydrides. Compare the boiling point of hydrogen sulfide with the boiling point of water and explain the difference.

_____ [3]

(iii) Write a half-equation for the oxidation of hydrogen sulfide to sulfur.

_____ [1]

(iv) Write a half-equation for the reduction of nitric acid to nitrogen(II) oxide.

_____ [1]

(v) Combine the two half-equations from **(a)(iii)** and **(a)(iv)** to give the overall redox equation for the reaction between hydrogen sulfide and nitric acid.

_____ [1]



(b) Sulfur reacts with sodium to form the ionic compound, sodium sulfide.

(i) Describe the bonding and structure of sodium.

[2]

(ii) Write the electronic configurations of an atom of sodium and an atom of sulfur.

sodium: _____

sulfur: _____ [2]

(iii) Draw a dot and cross diagram, using outer electrons only, to show the formation of sodium sulfide from atoms of sodium and sulfur.

[2]

[Turn over



(iv) Hydrated sodium sulfide ($\text{Na}_2\text{S} \cdot x\text{H}_2\text{O}$) is used in the Kraft process for the conversion of wood into wood pulp, the main component of paper. A sample of hydrated sodium sulfide contains 59% sodium sulfide by mass. Calculate the value of x in the sample of hydrated sodium sulfide.

Answer _____ [3]



(c) Sulfur reacts with carbon to form carbon disulfide which has a molecular covalent structure. A molecule of carbon disulfide has a shape similar to that of carbon dioxide.

(i) Explain why carbon disulfide does not conduct electricity.

[1]

(ii) Carbon disulfide contains polar bonds. Define the term **polar bond**.

[1]

(iii) State and explain whether a charged rod would deflect a stream of carbon disulfide flowing from a burette.

[1]

[Turn over



15 The identity of M in an unknown anhydrous metal carbonate, M_2CO_3 , may be determined by titration. A solution containing 2.60 g of M_2CO_3 in 500 cm^3 of deionised water was prepared and portions of this solution were titrated against a standard solution of hydrochloric acid.

(a) Describe how the 500 cm^3 solution of M_2CO_3 was prepared from 2.60 g of solid M_2CO_3 .

[5]

(b) (i) Define the term **standard solution**.

[1]

(ii) Before use in the titration, a sample of 50.0 cm^3 of 0.175 mol dm^{-3} hydrochloric acid was diluted to obtain a solution of concentration 0.100 mol dm^{-3} .

Calculate the volume of deionised water, in cm^3 , required to dilute the hydrochloric acid. Give your answer to 3 significant figures.

Answer _____ cm^3 [3]



- (c) In the titration, 25.0 cm³ portions of the solution of the weak base, M₂CO₃, were titrated against 0.100 mol dm⁻³ hydrochloric acid. A mean titre of 24.5 cm³ was obtained. The equation for the reaction may be represented by:



- (i) State and explain which indicator is required for use in this titration and give the colour change at the end point.

Indicator: _____

Explanation: _____

Colour change at end point:

From _____ to _____ [3]

- (ii) Determine the identity of M in M₂CO₃ using the mean titre and the mass of solid M₂CO₃.

Answer _____ [4]

- (d) Metal carbonates, such as M₂CO₃, are often used in their hydrated form. State and explain the effect, if any, on the mean titre in this titration if 2.60 g of hydrated M₂CO₃ were used rather than the anhydrous form of M₂CO₃.

_____ [2]



THIS IS THE END OF THE QUESTION PAPER

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For Examiner's use only	
Question Number	Marks
Section A	
1–10	
Section B	
11	
12	
13	
14	
15	
Total Marks	

Examiner Number

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SCH14/6
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General Information

1 tonne = 10^6 g

1 metre = 10^9 nm

One mole of any gas at 293 K and a pressure of 1 atmosphere (10^5 Pa) occupies a volume of 24 dm³

Avogadro Constant = 6.02×10^{23} mol⁻¹

Planck Constant = 6.63×10^{-34} Js

Specific Heat Capacity of water = $4.2 \text{ J g}^{-1} \text{ K}^{-1}$

Speed of Light = $3 \times 10^8 \text{ m s}^{-1}$



Characteristic absorptions in IR spectroscopy

Wavenumber/cm ⁻¹	Bond	Compound
550–850	C–X (X = Cl, Br, I)	Haloalkanes
750–1100	C–C	Alkanes, alkyl groups
1000–1300	C–O	Alcohols, esters, carboxylic acids
1450–1650	C=C	Arenes
1600–1700	C=C	Alkenes
1650–1800	C=O	Carboxylic acids, esters, aldehydes, ketones, amides, acyl chlorides
2200–2300	C≡N	Nitriles
2500–3200	O–H	Carboxylic acids
2750–2850	C–H	Aldehydes
2850–3000	C–H	Alkanes, alkyl groups, alkenes, arenes
3200–3600	O–H	Alcohols
3300–3500	N–H	Amines, amides

Proton Chemical Shifts in Nuclear Magnetic Resonance Spectroscopy (relative to TMS)

Chemical Shift	Structure	
0.5–2.0	–CH	Saturated alkanes
0.5–5.5	–OH	Alcohols
1.0–3.0	–NH	Amines
2.0–3.0	–CO–CH	Ketones
	–N–CH	Amines
	C ₆ H ₅ –CH	Arene (aliphatic on ring)
2.0–4.0	X–CH	X = Cl or Br (3.0–4.0) X = I (2.0–3.0)
4.5–6.0	–C=CH	Alkenes
5.5–8.5	RCONH	Amides
6.0–8.0	–C ₆ H ₅	Arenes (on ring)
9.0–10.0	–CHO	Aldehydes
10.0–12.0	–COOH	Carboxylic acids

These chemical shifts are concentration and temperature dependent and may be outside the ranges indicated above.

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Data Leaflet

Including the Periodic Table of the Elements

For the use of candidates taking
Advanced Subsidiary and
Advanced Level Examinations

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chemistry

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	–N–CH	Amines
	C ₆ H ₅ –CH	Arene (aliphatic on ring)
2.0–4.0	X–CH	X = Cl or Br (3.0–4.0) X = I (2.0–3.0)
4.5–6.0	–C=CH	Alkenes
5.5–8.5	RCONH	Amides
6.0–8.0	–C ₆ H ₅	Arenes (on ring)
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