

Group 7

Question Paper

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Chemistry Lab Skills 1
Sub Topic	Group 7
Booklet	Question Paper

Time Allowed: 57 minutes

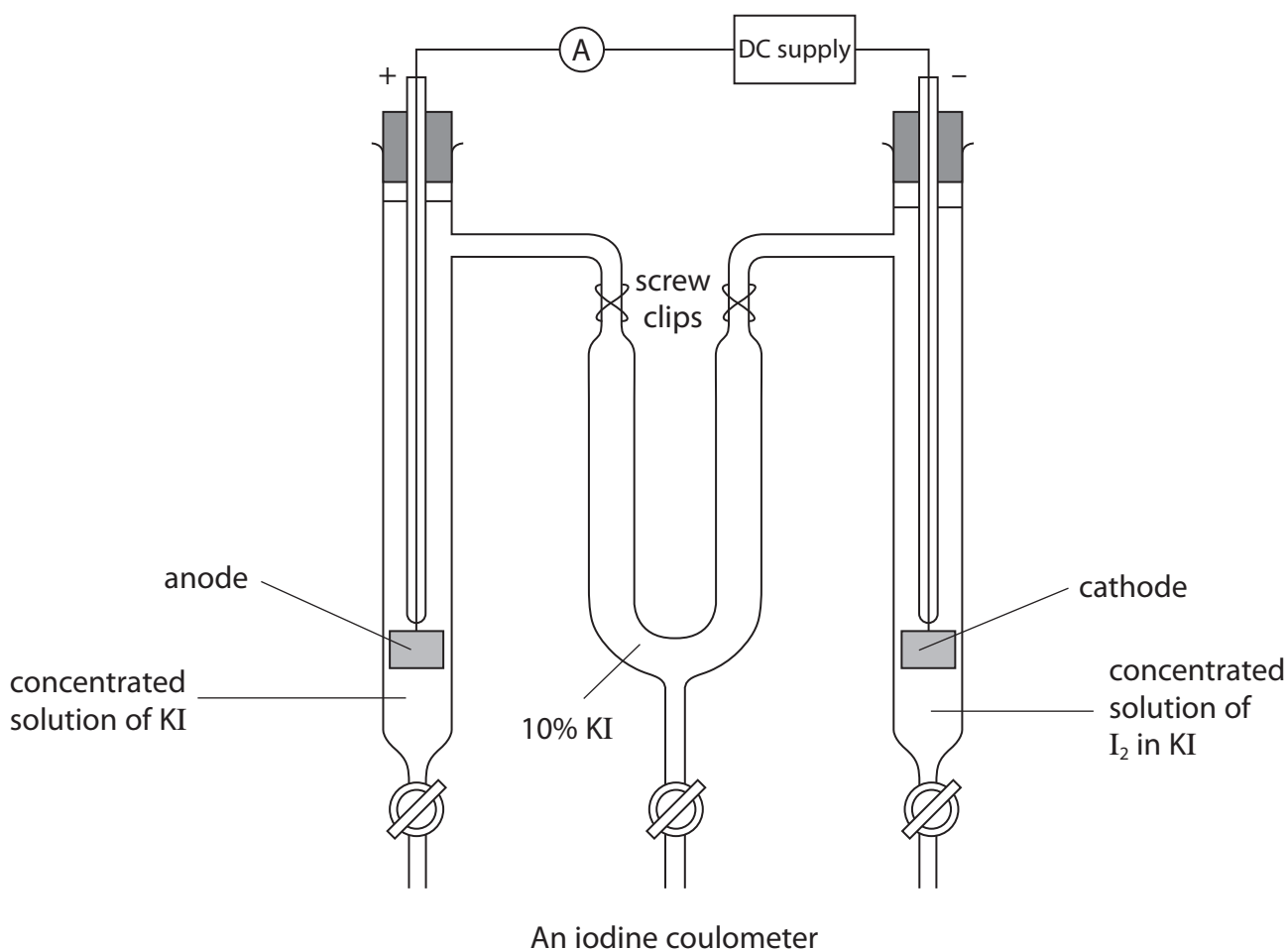
Score: /47

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

- 1 An iodine coulometer can be used to find the equation for the reaction between iodine and sodium thiosulfate.



The DC supply is switched on for 15.0 minutes.

The constant current, measured by the ammeter, is 0.200 A.

The screw clips are closed, the left-hand bung is removed and the contents of the anode (positive electrode) tube are run into a 100 cm³ volumetric flask. The tube and electrode are rinsed with a little distilled water and the washings added to the volumetric flask. The solution in the volumetric flask is made up to the mark with distilled water and mixed thoroughly.

10.0 cm³ portions of the contents of the volumetric flask are now titrated with 0.0100 mol dm⁻³ sodium thiosulfate solution.

- (a) (i) Name the indicator used for the titration, and give the colour change seen at the end-point.

(2)

Indicator

Colour change from to

(ii) State the appearance of the titration mixture just before the indicator is added.

(1)

.....
.....
(b) Calculate the number of moles of electrons transferred from the iodide ions to form iodine in the experiment. Use the expression

$$\text{number of moles of electrons} = \frac{\text{current (A)} \times \text{time (s)}}{96\,500}$$

(1)

(c) The total volume of solution in the volumetric flask is 100 cm³.

10.0 cm³ portions of the mixture are titrated with 0.0100 mol dm⁻³ sodium thiosulfate solution.

The results are given in the table below.

Titration number	1	2		
Second reading / cm ³	19.45	38.05	19.05	38.25
First reading / cm ³	0.00	19.45	0.00	19.55
Titre / cm ³				

(i) Complete the table.

(1)

(ii) Which result(s) should be discarded? Give a reason for your answer.

(2)

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.....

.....

.....

(iii) Calculate the mean titre for the remaining values.

(1)

(iv) Calculate the number of moles of thiosulfate ions in this mean titre.

(1)

(v) Calculate the number of moles of thiosulfate ions needed to react with the total amount of iodine in the 100 cm³ of solution in the flask.

(1)

- (d) (i) Complete the ionic half-equations for the oxidation of thiosulfate ions and the oxidation of iodide ions.

(2)



- (ii) In part (b), you calculated the number of moles of electrons lost when the iodide ions are oxidised to form the amount of iodine in the flask.

In part (c)(v), you calculated the number of moles of thiosulfate ions required to reduce this iodine back to iodide ions.

Show that the results calculated from the two experiments are consistent with your ionic half-equations.

(1)

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.....

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- (e) (i) The uncertainty in each burette reading is $\pm 0.05 \text{ cm}^3$ and the uncertainty in the volume reading for the pipette is $\pm 0.04 \text{ cm}^3$. Calculate the percentage uncertainties for the first burette titre and for the pipette volume of 10.0 cm^3 .

(2)

Burette uncertainty = %

Pipette uncertainty = %

- (ii) Explain whether these uncertainties are significant in this experiment.

(1)

.....

.....

(Total for Question 1 = 16 marks)

2 A white solid, **A**, has one metal cation and an anion consisting of two or more elements.

(a) A flame test is carried out on compound **A** by mixing the solid with concentrated hydrochloric acid and using a wire to place some of the mixture formed in the hottest part of a Bunsen flame.

(i) The wire is made from a metal or an alloy. Name a suitable material for the wire and give **one** reason why this material is used.

(2)

Material

Reason

(ii) Suggest **one** reason for using hydrochloric acid in this test, rather than another strong acid.

(1)

(iii) In a flame test for solid **A**, a red colour is observed. Identify, by name or formula, one Group 1 metal ion and one Group 2 metal ion that could be present.

(2)

Group 1 metal ion

Group 2 metal ion

(b) When solid **A** is added to water, some dissolves to form a colourless solution.

When phenolphthalein is added to this mixture, it turns pink.

When dilute hydrochloric acid is added to the mixture, the temperature increases and a colourless solution forms, but no gas is given off.

(i) Identify, by name or formula, the anion present in **A**.

(1)

(ii) Write the **ionic** equation for the reaction that causes the temperature to increase. State symbols are not required.

(1)

(c) When dilute sulfuric acid is added to the solution of **A**, a white precipitate forms.

(i) Name the white precipitate.

(1)

(ii) Write the **ionic** equation, including state symbols, for the formation of this precipitate.

(1)

(d) Give the formula of the white solid, **A**.

(1)

(Total for Question 2 = 10 marks)

3 Tests were carried out on compounds **P** and **Q**. Complete the tables below.

(a) Compound **P** is a white inorganic solid which contains one cation and one anion.

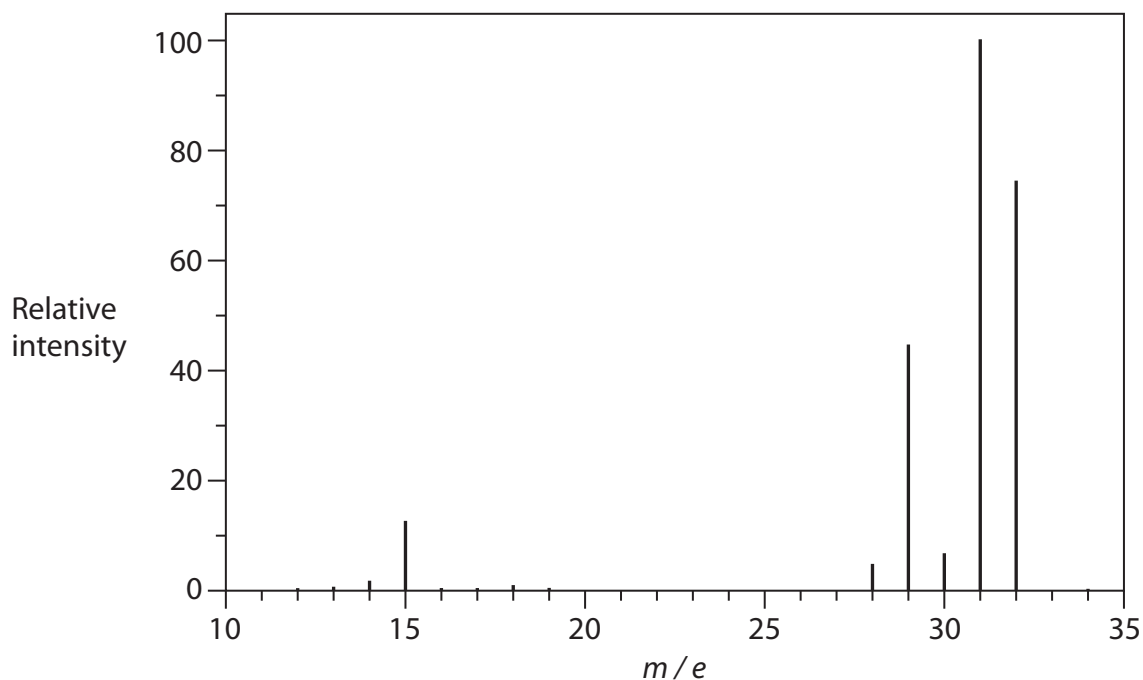
	Test	Observation	Inference (Name or formula)	
(i)	Warm P with dilute aqueous sodium hydroxide	A gas is given off which turns damp red litmus paper blue	The gas is	(1)
(ii)	Add dilute nitric acid followed by aqueous silver nitrate to an aqueous solution of P	A cream coloured precipitate forms	P contains the ion	(1)
(iii)	Add dilute aqueous ammonia to the cream coloured precipitate	..... .....	This confirms the inference in (a)(ii)	(1)

(iv) The **formula** of **P** is (1)

(b) **Q** is an organic liquid which has only one functional group. **Q** dissolves in water forming a **neutral** solution.

	Test	Observation	Inference	
(i)	Add bromine water to Q	The bromine is not decolorised	..... .....	(1)
(ii)	Add phosphorus(V) chloride to Q	Misty fumes which react with ammonia to form a white smoke	The misty fumes are The formula of the functional group in Q is	(2)
(iii)	Add a small piece of sodium to Q	..... .....	This confirms the inference made in (b)(ii)	(1)

(iv) The mass spectrum of **Q** is shown below.



Identify **Q** by name or formula. Use information from the spectrum to justify your answer.

(2)

Identity of **Q**

Justification

.....

.....

(Total for Question 3 = 10 marks)

- 4 (a) A series of tests is carried out on a white solid, **X**, which contains one cation and one anion.

Complete the table below.

	Test	Observation	Inference (Name or formula)	
(i)	Carry out a flame test on X	A persistent yellow colour	The cation in X is	(1)
(ii)	Add dilute hydrochloric acid to the solid X	Effervescence	The anion in X is	(1)
	Bubble the gas given off into limewater	The limewater turns cloudy		

- (iii) Write a balanced equation, including state symbols, for the reaction between the gas formed in the reaction in (a)(ii) and limewater (calcium hydroxide solution).

(2)

- (b) Another white solid, **Y**, also contains one cation and one anion.

Complete the table below.

	Test	Observation	Inference	
(i)	Carry out a flame test on Y	.....	Strontium ions are present	(1)
(ii)	Add dilute nitric acid and dilute aqueous silver nitrate to a solution of Y	.....	The anion in Y is probably a chloride	(1)

(iii) A further test is carried out on the mixture formed in (b)(ii). This confirms that **Y** contains chloride ions, and **not** bromide or iodide ions.

Describe this test and give the result.

(2)

Test.....

.....

Result.....

.....

(iv) What would you observe when the mixture formed in (b)(ii) is left to stand in sunlight?

Name the **product** responsible for this observation.

(2)

Observation.....

Product.....

(c) When aqueous solutions of **X** and **Y** are mixed, a white precipitate forms.

Write an **ionic** equation for the reaction which produces the white precipitate.
State symbols are not required.

(1)

(Total for Question 4 = 11 marks)

5 A series of tests was carried out on **X**, a white solid, which is known to contain one cation and one anion.

(a) **X** gave a pale green colour in a flame test. Give the name or formula of the cation in **X**.

(1)

(b) When dilute nitric acid was added to a sample of solid **X**, no reaction occurred. Suggest the name or formula of an anion that could **not** be present in **X**.

(1)

(c) Dilute nitric acid was added to an aqueous solution of **X**, and then aqueous silver nitrate was added to the mixture. A white precipitate formed, which dissolved in dilute aqueous ammonia.

Give the name or formula of the anion in **X**.

(1)

(d) A sample of the white precipitate in (c) was left to stand in sunlight.

(i) What colour change would be seen?

(1)

(ii) Name the substance responsible for the new colour that appeared in (d)(i).

(1)

(e) **Dilute** sulfuric acid was added to an aqueous solution of **X**.

(i) What change would be observed?

(1)

(ii) Write an equation for the reaction in (e)(i). Include state symbols.

(2)

(f) (i) A few drops of **concentrated** sulfuric acid were added to a small portion of **solid X** in a test tube. Misty fumes, but no other vapours, were seen.

Identify these fumes by name or formula.

(1)

(ii) Describe a further **chemical** test to confirm the identity of the gas responsible for the misty fumes.

Give the expected result of the test.

(2)

Test

Result

(Total for Question 5 = 11 marks)

- 6 A series of tests was carried out on **A**, a white powder. **A** is known to contain one cation and one anion. Complete the table below. You may use names or formulae in your answers.

	Test	Observation	Inference	
(a)	Carry out a flame test on A.	.....	Cation is calcium.	(1)
(b)	Add a few drops of dilute nitric acid to an aqueous solution of A , followed by aqueous silver nitrate. Then add concentrated aqueous ammonia solution.	..... ..... ..... .....	Anion is probably iodide. This confirms the anion is iodide.	(2)
(c)	Add an aqueous solution of chlorine to an aqueous solution of A .	The colour of the resulting solution is	The colour is due to the formation of	(2)
(d)	Add an aqueous solution of starch to the mixture formed in (c).	The colour of the resulting mixture is	This confirms the inference made in (c).	(1)
(e)	Add a solution of sodium carbonate to an aqueous solution of A . When there is no further change, add dilute hydrochloric acid to the mixture.	A white precipitate forms. The precipitate dissolves in the acid and bubbles of gas are seen.	The precipitate is The gas is	(2)

(f) When **concentrated** sulfuric acid is added to a **solid** sample of **A**, there is a vigorous redox reaction.

(i) Identify, by name or formula, the product formed by the oxidation of the iodide ion in this reaction. Describe the appearance of this product.

(2)

Product

Appearance

(ii) Identify, by name or formula, one product formed when the concentrated sulfuric acid is reduced. Describe an observation you could make that shows this product has formed.

(2)

Product

Observation

.....

(Total for Question 6 = 12 marks)