

**Questions**

Q1.

This question is about iron(II) salts.

Describe a chemical test, and the expected result, to show that sulfate ions are present in a solution of iron(II) sulfate in water.

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**(Total for question = 2 marks)**

Q2.

This question is about halogens and redox reactions.

The boiling temperatures of three halogens are shown in the table.

Halogen	Boiling temperature / °C
chlorine	-35
bromine	59
iodine	184

Explain why the boiling temperatures increase from chlorine to iodine.

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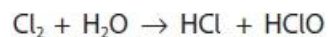
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**(Total for question = 2 marks)**

Q3.

This question is about chlorine and its compounds.

When chlorine gas is dissolved in water, it reacts according to the equation



The chloric(I) acid (HClO) produced is much more effective as a disinfectant than dissolved chlorine.

Chloric(I) acid is a weak acid and has little effect on the pH of the water.

Swimming pools usually have a chlorine content of 1 – 3 ppm.

**Use the equation** to explain one **disadvantage** of a chlorine content that is much lower than 1 ppm and one **disadvantage** of a chlorine content that is much higher than 3 ppm.

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(Total for question = 4 marks)

**Q4.**

An inorganic salt **A** contains one cation and one anion.  
The results of two tests on salt **A** are shown in the table.

Test	Observation
Add aqueous sodium hydroxide to solid <b>A</b> . Warm the mixture. Test any gas evolved with damp red litmus paper.	A gas was evolved. The gas turned red litmus paper blue.
Add dilute nitric acid followed by aqueous silver nitrate to an aqueous solution of <b>A</b> .	A cream precipitate formed.

Describe additional tests, with the results, that will confirm the identity of the **anion** in the cream precipitate.

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**(Total for question = 2 marks)**

Edexcel Chemistry A-level - Group 7

Q5.

Compound **C** is a pink crystalline solid containing two cations and one anion.

Three tests were carried out on **C**. The observation made for each test was recorded in the table.

Test	Observation	Inference
<p><b>Test 1</b></p> <p>Aqueous sodium hydroxide was added to solid <b>C</b> and the mixture warmed</p> <p>The gas evolved was tested with damp red litmus paper</p>	<p>The red litmus paper turned blue</p>	<p>The gas evolved was .....</p> <p>One of the cations in <b>C</b> is .....</p>
<p><b>Test 2</b></p> <p>Concentrated hydrochloric acid was added to an aqueous solution of <b>C</b></p>	<p>The pink solution turned blue</p>	<p>The other cation in <b>C</b> is .....</p> <p>The formula of the complex ion in the blue solution is .....</p>
<p><b>Test 3</b></p> <p>Dilute hydrochloric acid and aqueous barium chloride were added to an aqueous solution of <b>C</b></p>	<p>A white precipitate formed</p>	<p>The white precipitate is .....</p> <p>The anion in <b>C</b> is .....</p>

Give a reason why dilute hydrochloric acid is needed in **Test 3**.

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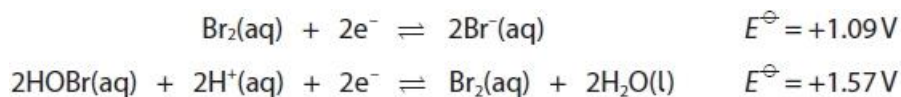
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(Total for question = 1 mark)

Q6.

This question is about the elements in Group 7 of the Periodic Table and some of their compounds.

The standard electrode potentials for two half-equations involving bromine are given.



(i) Explain why the disproportionation of bromine in water is **not** thermodynamically feasible under standard conditions. Include the overall equation for the disproportionation and its  $E_{\text{cell}}^\ominus$  value.

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(ii) Bromine disproportionates in water to a small extent at 298 K.

Give a possible reason why this reaction occurs.

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**(Total for question = 4 marks)**

Q7.

This question is about some redox reactions of chlorine, bromine and iodine.

Chlorine undergoes disproportionation when it reacts with **hot** aqueous sodium hydroxide solution.

(i) Complete the ionic equation for this reaction. State symbols are not required.

(1)



(ii) Explain, in terms of oxidation numbers, why this is a disproportionation reaction.

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**(Total for question = 3 marks)**

**Edexcel Chemistry A-level - Group 7**

**Q8.**

This question is about redox chemistry.

A different ion containing chlorine is formed if the solution of aqueous hydroxide ions is hot.

Give the formula of the chlorine-containing ion **and** the oxidation number of chlorine in this ion.

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**(Total for question = 2 marks)**



Q9.

This question is about halogens and redox reactions.

Potassium halides react with concentrated sulfuric acid to form potassium hydrogensulfate and the different products shown in the table.

Potassium halide	Products
potassium chloride	hydrogen chloride
potassium bromide	hydrogen bromide, bromine and sulfur dioxide
potassium iodide	hydrogen iodide, iodine, hydrogen sulfide and sulfur

By referring to any changes in oxidation numbers when these halides react with concentrated sulfuric acid, explain which halide is the strongest reducing agent.

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(Total for question = 3 marks)

**Q10.**

This question is about some reactions of chlorine and hydrogen chloride.

Hydrogen chloride gas dissolves in water to form hydrochloric acid.

(i) Hydrogen chloride gas does not conduct electricity.

Hydrochloric acid is a good conductor of electricity.

Give a reason for this change in conductivity.

(1)

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(ii) When concentrated hydrochloric acid on a glass rod is held above a concentrated ammonia solution, a white smoke is observed.

Write an equation, including state symbols, for the reaction that produces the white smoke.

(2)

(iii) Hydrochloric acid is added to a test tube containing a sample of solid sodium carbonate.

Give **two** observations.

(2)

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(iv) Describe an experiment to enable you to accurately determine the concentration of an approximately  $1 \text{ mol dm}^{-3}$  solution of hydrochloric acid, using a solution of sodium hydroxide of concentration  $1.00 \text{ mol dm}^{-3}$ . Details of the calculation are not required.

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**(Total for question = 10 marks)**

Q11.

An inorganic salt **A** contains one cation and one anion.  
The results of two tests on salt **A** are shown in the table.

Test	Observation
Add aqueous sodium hydroxide to solid <b>A</b> . Warm the mixture. Test any gas evolved with damp red litmus paper.	A gas was evolved. The gas turned red litmus paper blue.
Add dilute nitric acid followed by aqueous silver nitrate to an aqueous solution of <b>A</b> .	A cream precipitate formed.

Deduce the **name** of salt **A**.

(2)

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(Total for question = 2 marks)

Q12.

Compound **C** is a pink crystalline solid containing two cations and one anion.

Three tests were carried out on **C**. The observation made for each test was recorded in the table.

Test	Observation	Inference
<p><b>Test 1</b></p> <p>Aqueous sodium hydroxide was added to solid <b>C</b> and the mixture warmed</p> <p>The gas evolved was tested with damp red litmus paper</p>	<p>The red litmus paper turned blue</p>	<p>The gas evolved was .....</p> <p>One of the cations in <b>C</b> is .....</p>
<p><b>Test 2</b></p> <p>Concentrated hydrochloric acid was added to an aqueous solution of <b>C</b></p>	<p>The pink solution turned blue</p>	<p>The other cation in <b>C</b> is .....</p> <p>The formula of the complex ion in the blue solution is .....</p>
<p><b>Test 3</b></p> <p>Dilute hydrochloric acid and aqueous barium chloride were added to an aqueous solution of <b>C</b></p>	<p>A white precipitate formed</p>	<p>The white precipitate is .....</p> <p>The anion in <b>C</b> is .....</p>

(b) Write the **ionic** equation for the reaction between the cation in **C** and sodium hydroxide producing the gas in **Test 1**.

State symbols are not required.

(1)

(Total for question = 1 mark)

**Q13.**

This question is about redox chemistry.

- (i) Bromine can be extracted from seawater containing bromide ions using chlorine.

Write the ionic equation for this reaction. State symbols are not required.

(1)

- (ii) Identify **one** hazard associated with carrying out this reaction in a school laboratory and a safety precaution other than wearing a laboratory coat and eye protection.

(2)

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**(Total for question = 3 marks)**

## Edexcel Chemistry A-level - Group 7

### Q14.

The halogens are elements in Group 7 of the Periodic Table.

Halide ions can be identified by their reaction with silver nitrate.

(i) Write the **ionic** equation for the reaction between aqueous solutions of sodium iodide and silver nitrate.

Include state symbols.

(2)

(ii) A solution containing 0.010 mol of a halide ion was reacted with excess silver nitrate and produced 1.88 g of precipitate.

Identify the halide ion.

Justify your answer.

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**(Total for question = 4 marks)**

## Edexcel Chemistry A-level - Group 7

Q15.

Tests are carried out on aqueous solutions of two salts, **X** and **Y**.

**X** contains one cation and one anion.

The observations for each test are recorded in the table.

(i) Complete the table by writing the names or formulae of the species.

(2)

Test	Observation	Inference
<b>Test 1</b> Add aqueous sodium hydroxide to an aqueous solution of <b>X</b>	A green precipitate forms The precipitate turns brown on the top after a few minutes	The cation in <b>X</b> is ..... .....
<b>Test 2</b> To an aqueous solution of <b>X</b> , add dilute hydrochloric acid followed by aqueous barium chloride	A white precipitate forms	The anion in <b>X</b> is ..... .....

(ii) Write the ionic equation for the reaction between the cation in **X** and aqueous sodium hydroxide in **Test 1**. Include state symbols.

(2)

(iii) Give a reason why the green precipitate turns brown on the top after a few minutes.

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(iv) Give a reason why dilute hydrochloric acid is needed in **Test 2**.

(1)

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(Total for question = 6 marks)



**Edexcel Chemistry A-level - Group 7**

**Q16.**

This question is about redox chemistry.

(i) Write an ionic half-equation for the reduction of chlorine molecules to chloride ions.

State symbols are not required.

(1)

(ii) Write an ionic half-equation for the oxidation of chlorine molecules to chlorate(I) ions in the presence of cold, aqueous hydroxide ions.

State symbols are not required.

(1)

(iii) Combine the two equations in (i) and (ii) to give the ionic equation for the reaction of chlorine molecules with cold, aqueous hydroxide ions.

(1)

(iv) Use your answer to (iii) to explain why the reaction is described as a **disproportionation** reaction.

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**(Total for question = 5 marks)**

Q17.

This question is about some halogens and their compounds.

The intermolecular attractions between halogen molecules are London forces.

(i) Describe how London forces form between halogen molecules.

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(ii) The boiling temperatures of chlorine and bromine are shown in the table.

Halogen	Boiling temperature / °C
chlorine	-34
bromine	59

Explain why bromine has a higher boiling temperature than chlorine.

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(Total for question = 5 marks)

Q18.

Compound **C** is a pink crystalline solid containing two cations and one anion.

Three tests were carried out on **C**. The observation made for each test was recorded in the table.

(i) Complete the statements in the inference column by writing the names or formulae of the species.

(6)

Test	Observation	Inference
<p><b>Test 1</b></p> <p>Aqueous sodium hydroxide was added to solid <b>C</b> and the mixture warmed</p> <p>The gas evolved was tested with damp red litmus paper</p>	<p>The red litmus paper turned blue</p>	<p>The gas evolved was</p> <p>.....</p> <p>One of the cations in <b>C</b> is</p> <p>.....</p>
<p><b>Test 2</b></p> <p>Concentrated hydrochloric acid was added to an aqueous solution of <b>C</b></p>	<p>The pink solution turned blue</p>	<p>The other cation in <b>C</b> is</p> <p>.....</p> <p>The formula of the complex ion in the blue solution is</p> <p>.....</p>
<p><b>Test 3</b></p> <p>Dilute hydrochloric acid and aqueous barium chloride were added to an aqueous solution of <b>C</b></p>	<p>A white precipitate formed</p>	<p>The white precipitate is</p> <p>.....</p> <p>The anion in <b>C</b> is</p> <p>.....</p>

(ii) Use the results of the tests in (i) to give a formula of **C**.  
Do not include water of crystallisation.

(1)

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(Total for question = 7 marks)

**Q19.**

This question is about some halogens and their compounds.

A student carries out experiments to determine the order of reactivity of three halogens: bromine, chlorine and iodine.

The student is provided with aqueous solutions of the following five substances:

- bromine
- iodine
- potassium chloride
- potassium bromide
- potassium iodide.

The student has **no** access to chlorine gas or chlorine water.

The student uses cyclohexane, an organic solvent, to identify the halogen present at the end of each experiment.

The student carries out the **smallest** number of experiments required to determine the order of reactivity of the halogens.

Describe the experiments and the expected observations.

Include in your answer **ionic** equations for any reactions that occur.

State symbols are **not** required.

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**(Total for question = 5 marks)**

## Edexcel Chemistry A-level - Group 7

Q20.

Answer the question with a cross in the box you think is correct  . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross  .

The halogens are elements in Group 7 of the Periodic Table.

Sodium chlorate(I) is a bleaching agent.

(i) Sodium chlorate(I) can be made by the reaction of chlorine with sodium hydroxide.

Show, by using oxidation numbers, that this reaction is disproportionation.



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(ii) A different bleaching agent can be made by the reaction of chlorine with sodium hydroxide under different conditions.

Balance this equation.



(1)

(iii) What conditions are required for the reaction in (b)(ii)?

(1)

- A cold and dilute alkali
- B cold and concentrated alkali
- C hot alkali
- D excess chlorine

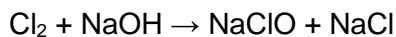
**(Total for question = 4 marks)**

Q21.

This question is about the reactions of the halogens and their salts.

The reaction that occurs between chlorine and sodium hydroxide depends on the temperature.

(i) At room temperature the reaction that occurs is



Explain, with reference to oxidation numbers, why this is a disproportionation reaction.

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(ii) With hot sodium hydroxide solution, a different disproportionation reaction occurs. Sodium chlorate(V) is one of the products.

Complete the equation for this reaction. State symbols are not required.

(2)



**(Total for question = 4 marks)**

**Q22.**

(i) Give the physical states of chlorine and iodine at room temperature and pressure.

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(ii) Predict the physical state of astatine under these conditions. Justify your answer.

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**(Total for question = 2 marks)**

## Edexcel Chemistry A-level - Group 7

Q23.

This question is about the reactions of the halogens and halide ions.

Potassium iodate(V) can be prepared by adding solid iodine to a **hot** aqueous solution of potassium hydroxide.

The equation for the reaction is



Potassium iodate(V) can be separated from the other reaction product using their differing solubilities in water.

Solubility in water at 25 °C / mol dm <sup>-3</sup>	
KI	8.92
KIO <sub>3</sub>	0.43

(i) Outline a procedure that you could use to obtain a sample of dry, solid potassium iodate(V) from the reaction mixture.

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(ii) Describe how you would show that iodide ions are present in an aqueous solution of potassium iodide.

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**(Total for question = 5 marks)**



**Q24.**

Aqueous sodium carbonate and aqueous sodium sulfate are both colourless solutions.

Give the reagent and the observation to show the presence of carbonate ions.

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**(Total for question = 2 marks)**

**Q25.**

Aqueous sodium carbonate and aqueous sodium sulfate are both colourless solutions.

Give the reagent and the observation to show the presence of sulfate ions.

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**(Total for question = 2 marks)**

**Edexcel Chemistry A-level - Group 7**

**Q26.**

Write the equation for the reaction of chlorine with cold, dilute sodium hydroxide solution to form bleach. Name this type of reaction.

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Type of reaction

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**(Total for question = 2 marks)**

Q27.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

This question is about chlorine and its compounds.

Potassium chlorate(V) can be produced by passing chlorine gas into hot, concentrated potassium hydroxide solution.

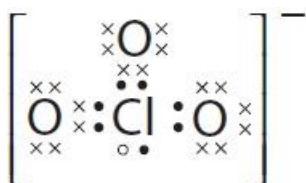


(i) This reaction is an example of

(1)

- A** oxidation only  
 **B** reduction only  
 **C** disproportionation  
 **D** decomposition

(ii) A dot-and-cross diagram for the chlorate(V) ion ( $\text{ClO}_3^-$ ) is shown.



Key

- = chlorine electrons
- = an added electron
- × = oxygen electrons

Predict the shape and bond angle ( $\text{O}-\text{Cl}-\text{O}$ ) of the chlorate(V) ion. Justify your answer.

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(Total for question = 5 marks)

Q28.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

This question is about the reactions of the halogens and halide ions.

(i) When chlorine gas is bubbled through an aqueous solution of potassium iodide, the reaction involves

(1)

- A oxidation only
- B reduction only
- C redox
- D disproportionation

(ii) Cyclohexane was added to the resulting solution from (i). The mixture was shaken and then allowed to stand for a few minutes. Two layers were formed.

[Density: aqueous layer solution =  $1.10 \text{ g cm}^{-3}$ , cyclohexane layer =  $0.78 \text{ g cm}^{-3}$ ]  
The colour of the **lower** layer was

(1)

- A pale yellow
- B purple
- C red
- D pale green

(Total for question = 2 marks)

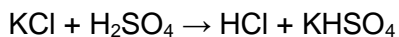
**Edexcel Chemistry A-level - Group 7**

**Q29.**

This question is about the reactions of the halogens and their salts.

The potassium halides react with concentrated sulfuric acid to form hydrogen halides.

(i) The equation for this reaction for potassium chloride can be written



The hydrogen chloride does not react further.  
State why this reaction is not a redox reaction.

**(1)**

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(ii) On descending Group 7, the hydrogen halides become better reducing agents.

Explain how the reactions of potassium chloride, potassium bromide and potassium iodide with concentrated sulfuric acid provide evidence for this statement.  
No explanation of the trend is required.

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**(Total for question = 4 marks)**

**Q30.**

This question is about some redox reactions of chlorine, bromine and iodine.

An **excess** of aqueous potassium bromide was added to chlorine water and the solution turned orange.

(i) Write an equation for this reaction. State symbols are not required.

(1)

(ii) Silver nitrate solution was added to the mixture in (i) and excess dilute ammonia solution was then added to the precipitate formed.

Only some of the precipitate dissolved.

Deduce why only **some** of the precipitate dissolved.

(3)

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(iii) Aqueous potassium bromide was added to aqueous iodine, instead of chlorine water. There was no reaction.

Give a reason why no reaction occurred.

(1)

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**(Total for question = 5 marks)**

**Edexcel Chemistry A-level - Group 7**

**Q31.**

This question is about tests for ions.

An aqueous solution is suspected to be potassium bromide and is tested for the presence of the anion.

(i) Write the **name** of the reagent used to test for the anion.

(1)

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(ii) State the expected result of this test and the **formula** of the product.

(2)

Result of test

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Formula of the product

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**(Total for question = 3 marks)**