

AS LEVEL CHEMISTRY

TOPIC 6 – REDOX, GROUP 2 AND GROUP 7 TEST

Answer all questions

Max 50 marks

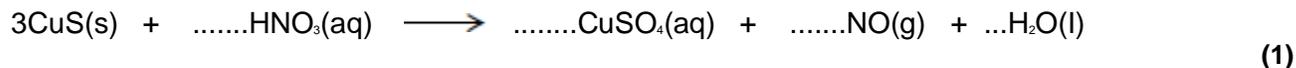
Name		
Mark/50%	Grade

SECTION A

1. The price of copper is increasing as supplies of high-grade ores start to run out. The mineral covellite (CuS), found in low-grade ores, is a possible future source of copper.

(a) When copper is extracted from covellite, a reaction occurs between copper(II) sulfide and nitric acid to form a dilute solution of copper(II) sulfate.

(i) Balance the equation for this reaction.



(ii) Give the oxidation state of nitrogen in each of the following.

HNO₃.....

NO

(2)

(iii) Deduce the redox half-equation for the reduction of the nitrate ion in acidified solution to form nitrogen monoxide and water.

.....

(1)

(iv) Deduce the redox half-equation for the oxidation of the sulfide ion in aqueous solution to form the sulfate ion and H⁺(aq) ions.

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(1)

(Total 5 marks)

2. In acidified aqueous solution, nitrate ions, NO₃⁻, react with copper metal forming nitrogen monoxide, NO, and copper(II) ions.

(i) Write a half-equation for the oxidation of copper to copper(II) ions.

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(ii) Write a half-equation for the reduction, in an acidified solution, of nitrate ions to nitrogen monoxide.

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(iii) Write an overall equation for this reaction.

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(3)

(Total 3 marks)

3. (a) Strontium chloride is used in toothpaste for sensitive teeth.
Both strontium carbonate and strontium sulfate are white solids that are insoluble in water.

(i) Write an equation for the reaction between strontium chloride solution and sodium sulfate solution.
Include state symbols in your equation.

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(1)

(ii) Strontium carbonate reacts with nitric acid to produce a solution of strontium nitrate.
Strontium sulfate does not react with nitric acid.

Describe briefly how you could obtain strontium sulfate from a mixture of strontium carbonate and strontium sulfate.

You are **not** required to describe the purification of the strontium sulfate.

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(2)

(b) A solution of magnesium sulfate is sometimes given as first aid to someone who has swallowed barium chloride.

Explain why drinking magnesium sulfate solution is effective in the treatment of barium poisoning.

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(1)

(c) Medicines for the treatment of nervous disorders often contain calcium bromide.
Silver nitrate, acidified with dilute nitric acid, can be used together with another reagent to test for the presence of bromide ions in a solution of a medicine.

Describe briefly how you would carry out this test and state what you would observe.

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(3)

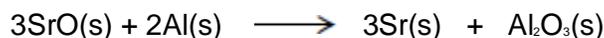
(Total 7 marks)

4. Group 2 metals and their compounds are used commercially in a variety of processes.

- (a) Strontium is extracted from strontium oxide (SrO) by heating a mixture of powdered strontium oxide and powdered aluminium.

Consider these standard enthalpies of formation.

	SrO(s)	Al ₂ O ₃ (s)
$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	- 590	- 1669



Use these data and the equation to calculate the standard enthalpy change for this extraction of strontium.

The use of powdered strontium oxide and powdered aluminium increases the surface area of the reactants.

Suggest **one** reason why this increases the reaction rate.

Suggest **one** major reason why this method of extracting strontium is expensive.

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(5)

- (b) Explain why calcium has a higher melting point than strontium.

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(2)

- (c) Magnesium is used in fireworks. It reacts rapidly with oxygen, burning with a bright white light. Magnesium reacts slowly with cold water.

Write an equation for the reaction of magnesium with oxygen.

Write an equation for the reaction of magnesium with cold water.

Give a medical use for the magnesium compound formed in the reaction of magnesium with cold water.

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(3)
(Total 10 marks)

5. Barium chloride solution was added, dropwise, to magnesium sulfate solution until no more white precipitate was formed. The mixture was filtered.

Give the formulae of the **two** main ions in the filtrate.

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(Total 1 mark)

6. A chemical company's records refer to the following acids

hydrochloric acid
hydrobromic acid
hydriodic acid

nitric acid
sulfuric acid

A waste tank was thought to contain a mixture of two of these acids. A chemist performed test-tube reactions on separate samples from the waste tank. The results of these tests are shown below.

Test	Reagent	Observations
A	Barium chloride solution	White precipitate
B	Silver nitrate solution	White precipitate

(a) Use the result from Test **A** to identify an acid in the company's records which must be **present** in the waste tank.

.....

(1)

(b) Use the results from Test **A** and Test **B** to identify an acid in the company's records which must be **absent** from the waste tank.

.....

(1)

(c) The chemist suspected that the waste tank contained hydrochloric acid. State how the precipitate formed in Test **B** could be tested to confirm the presence of hydrochloric acid in the waste tank. State what you would observe.

Test

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Observation

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(2)

(d) Suggest one reason why carbonate ions could not be present in the waste tank.

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(1)

(Total 5 marks)

7. (a) State and explain the trend in electronegativity down Group VII from fluorine to iodine.

Trend

Explanation

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.....

(3)

(b) State what you would observe when chlorine gas is bubbled into an aqueous solution of potassium iodide. Write an equation for the reaction that occurs.

Observation

Equation

(2)

(c) Identify **two** sulphur-containing reduction products formed when concentrated sulphuric acid oxidises iodide ions. For each reduction product, write a half-equation to illustrate its formation from sulphuric acid.

Reduction product 1

Half-equation

Reduction product 2

Half-equation

(4)

(d) Write an equation for the reaction between chlorine gas and dilute aqueous sodium hydroxide. Name the **two** chlorine-containing products of this reaction and give the oxidation state of chlorine in each of these products.

Equation

Name of product 1

Oxidation state of chlorine in product 1

Name of product 2

Oxidation state of chlorine in product 2

(5)

(Total 14 marks)

SECTION B

8. Which one of the following statements concerning halogen chemistry is true?
- A Sodium chloride produces chlorine when treated with concentrated sulphuric acid.
 - B Sodium chloride produces chlorine when treated with bromine.
 - C Sodium bromide produces bromine when treated with concentrated sulphuric acid.
 - D Sodium bromide produces bromine when treated with iodine in aqueous potassium iodide.
- (Total 1 mark)**
9. On heating, magnesium reacts vigorously with element **X** to produce compound **Y**. An aqueous solution of **Y**, when treated with aqueous silver nitrate, gives a white precipitate that is readily soluble in dilute aqueous ammonia. What is the minimum mass of **X** that is needed to react completely with 4.05 g of magnesium?
- A 11.83 g
 - B 5.92 g
 - C 5.33 g
 - D 2.67 g
- (Total 1 mark)**
10. The boiling points of the halogens increase down Group VII because
- A covalent bond strengths increase.
 - B bond polarities increase.
 - C the surface areas of the molecules increase.
 - D electronegativities increase.
- (Total 1 mark)**

11. Which one of the following is the electron arrangement of the strongest reducing agent?

- A $1s^2 2s^2 2p^5$
- B $1s^2 2s^2 2p^6 3s^2$
- C $1s^2 2s^2 2p^6 3s^2 3p^5$
- D $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

(Total 1 mark)

12. The reaction between sodium iodide and concentrated phosphoric acid produces hydrogen iodide but no iodine. The reaction of sodium iodide with concentrated sulphuric acid produces mainly iodine. The difference in product occurs because, in comparison with sulphuric acid, phosphoric acid is

- A the weaker acid.
- B the stronger oxidising agent.
- C the weaker oxidising agent.
- D the stronger reducing agent.

(Total 1 mark)