



AS LEVEL CHEMISTRY

TOPIC 6 – REDOX, GROUP 2 AND GROUP 7

ASSESSED HOMEWORK

Answer all questions

Max 80 marks

Name		
Mark/80%	Grade

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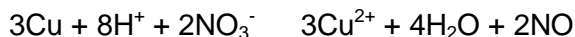
1. Oxidation and reduction can be defined in terms of electron transfer.

(a) Define the term *reduction* in terms of electrons.

.....

(1)

(b) The oxide of nitrogen formed when copper reacts with nitric acid depends upon the concentration and the temperature of the acid. The reaction of copper with cold, dilute acid produces NO as indicated by the following equation.



In warm, concentrated acid, NO₂ is formed.

Oxidation states can be used to understand electron transfer in these reactions.

(i) Give the oxidation states of nitrogen in NO₃⁻, NO and NO

Oxidation state in NO₃⁻

Oxidation state in NO₂

Oxidation state in NO

(ii) Identify, as oxidation or reduction, the formation of NO from NO₃⁻ ions in the presence of H⁺ ions. Deduce the half-equation for the reaction.

NO from NO₃⁻

Half-equation .;.

(iii) Deduce the half-equation for the formation of NO₂ from NO₃⁻ ions in the presence of H⁺ ions.

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(iv) Deduce the overall equation for the reaction of copper with NO₃⁻ ions and H⁺ ions to produce Cu²⁺ ions, NO₂ and water.

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(8)
(Total 9 marks)

2. (a) In terms of electron transfer, what does the reducing agent do in a redox reaction?

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(1)

(b) What is the oxidation state of an atom in an uncombined element?

.....

(1)

(c) Deduce the oxidation state of nitrogen in each of the following compounds.

(i) NCl_3

(ii) Mg_3N_2

(iii) NH_2OH

(3)

(d) Lead(IV) oxide, PbO_2 , reacts with concentrated hydrochloric acid to produce chlorine, lead(II) ions, Pb^{2+} , and water.

(i) Write a half-equation for the formation of Pb^{2+} and water from PbO_2 in the presence of H^+ ions.

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(ii) Write a half-equation for the formation of chlorine from chloride ions.

.....

(iii) Hence deduce an equation for the reaction which occurs when concentrated hydrochloric acid is added to lead(IV) oxide, PbO_2

.....

(3)

(Total 8 marks)

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3. There are many uses for Group 2 metals and their compounds.

- (a) State a medical use of barium sulfate.
State why this use of barium sulfate is safe, given that solutions containing barium ions are poisonous.

Use

Why this use is safe

.....
.....

(2)

- (b) Magnesium hydroxide is used in antacid preparations to neutralise excess stomach acid.

Write an equation for the reaction of magnesium hydroxide with hydrochloric acid.

.....

(1)

- (c) Solutions of barium hydroxide are used in the titration of weak acids.

State why magnesium hydroxide solution could **not** be used for this purpose.

.....
.....

(1)

- (d) Magnesium metal is used to make titanium from titanium(IV) chloride.

Write an equation for this reaction of magnesium with titanium(IV) chloride.

.....

(1)

- (e) Magnesium burns with a bright white light and is used in flares and fireworks.

Use your knowledge of the reactions of Group 2 metals with water to explain why water should **not** be used to put out a fire in which magnesium metal is burning.

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(2)

(Total 7 marks)

4. Group 2 elements and their compounds have a wide range of uses.

(a) For parts (a)(i) to (a)(iii), draw a ring around the correct answer to complete each sentence.

(i) From $\text{Mg}(\text{OH})_2$ to $\text{Ba}(\text{OH})_2$, the solubility in water

decreases.
increases.
stays the same.

(1)

(ii) From Mg to Ba, the first ionisation energy

decreases.
increases.
stays the same.

(1)

(iii) From Mg to Ba, the atomic radius

decreases.
increases.
stays the same.

(1)

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

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(2)

(c) Acidified barium chloride solution is used as a reagent to test for sulfate ions.

(i) State why sulfuric acid should **not** be used to acidify the barium chloride.

.....
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(1)

(ii) Write the **simplest ionic** equation for the reaction that occurs when acidified barium chloride solution is added to a solution containing sulfate ions.

.....

(1)

(Total 7 marks)

5. (a) Samples of solid sodium fluoride, sodium chloride, sodium bromide and sodium iodide are each warmed separately with concentrated sulphuric acid. All four compounds react with concentrated sulphuric acid but only two can reduce it.

(i) Identify the **two** halides which do **not** reduce concentrated sulphuric acid. Write an equation for the reaction which does occur with **one** of these two halides.

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(ii) Identify the **two** halides which reduce concentrated sulphuric acid to sulphur dioxide. Using half-equations for the oxidation and reduction processes, deduce an overall equation for the formation of sulphur dioxide when concentrated sulphuric acid reacts with **one** of these halides.

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(iii) In addition to sulphur dioxide, two further reduction products are formed when one of these two halides reacts with concentrated sulphuric acid. Identify the two reduction products and write a half-equation to show the formation of **one** of them from concentrated sulphuric acid.

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(9)

(b) How would you distinguish between separate solutions of sodium chloride, sodium bromide and sodium iodide using solutions of silver nitrate and ammonia?

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(6)

(Total 15 marks)

6. (a) Describe and explain the trend in the boiling points of the elements down Group VII from fluorine to iodine.

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(4)

- (b) Describe what you would observe when aqueous silver nitrate, followed by dilute aqueous ammonia, is added to separate aqueous solutions of sodium chloride and sodium bromide.

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(4)

- (c) State the trend in the oxidising abilities of the elements down Group VII from chlorine to iodine.
Explain how this trend can be shown by displacement reactions between halogens and halide ions in aqueous solutions.
Illustrate your answer with appropriate observations and equations

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(7)

(Total 15 marks)

7. (a) State the trend in electronegativity of the elements down Group VII. Explain this trend.

Trend

Explanation

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(3)

- (b) (i) State the trend in reducing ability of the halide ions down Group VII.

.....

- (ii) Give an example of a reagent which could be used to show that the reducing ability of bromide ions is different from that of chloride ions.

.....

(2)

- (c) The addition of silver nitrate solution followed by dilute aqueous ammonia can be used as a test to distinguish between chloride and bromide ions. For each ion, state what you would observe if an aqueous solution containing the ion was tested in this way.

Observations with chloride ions

.....

Observations with bromide ions

.....

(4)

- (d) Write an equation for the reaction between chlorine and cold, dilute aqueous sodium hydroxide. Give two uses of the resulting solution.

Equation

Use 1

Use 2

(3)

(Total 12 marks)

8. Which one of the following statements is true?

- A Bromine liberates iodine from aqueous sodium iodide.
- B Chlorine liberates fluorine from aqueous sodium fluoride.
- C Silver iodide is soluble in aqueous ammonia.
- D Concentrated sulphuric acid liberates chlorine from solid sodium chloride.

(Total 1 mark)

9. When vanadium reacts with chlorine at 400°C , a brown compound is obtained. When an aqueous solution containing 0.193 g of this compound was treated with aqueous silver nitrate all the chlorine in the compound was precipitated as silver chloride. The mass of silver chloride (AgCl) produced was 0.574 g. Which one of the following could be the formula of the brown compound?

- A VCl
- B VCl_2
- C VCl_3
- D VCl_4

(Total 1 mark)

10. Which one of the following is **not** a correct trend down Group VII?

- A The first ionisation energy of the atom decreases.
- B The oxidising power of the element increases.
- C The electronegativity of the atom decreases.
- D The boiling point of the element increases.

(Total 1 mark)

11. A white salt dissolves in water to give a solution which gives a cream coloured precipitate when aqueous silver nitrate is added. This precipitate is insoluble in dilute aqueous ammonia but is soluble in concentrated aqueous ammonia. The original white salt could be

- A AgI
- B NaI
- C AgBr
- D NaBr

(Total 1 mark)

12. In which one of the following reactions does the metal species undergo reduction?

- A $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$
- B $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 4\text{Cl}^- \rightarrow [\text{CuCl}_4]^{2-} + 6\text{H}_2\text{O}$
- C $\text{Cr}_2\text{O}_7^{2-} + 2\text{OH}^- \rightarrow 2\text{CrO}_4^{2-} + \text{H}_2\text{O}$
- D $\text{TiO}_2 + 2\text{C} + 2\text{Cl}_2 \rightarrow \text{TiCl}_4 + 2\text{CO}$

(Total 1 mark)

13. What will you see when a solution of silver nitrate is added to a solution containing bromide ions, and concentrated aqueous ammonia is added to the resulting mixture?

- A a white precipitate soluble in concentrated aqueous ammonia
- B a white precipitate insoluble in concentrated aqueous ammonia
- C a cream precipitate soluble in concentrated aqueous ammonia
- D a yellow precipitate insoluble in concentrated aqueous ammonia

(Total 1 mark)

14. An aqueous solution of a white solid gives a yellow precipitate with aqueous silver nitrate. The formula of the white solid could be

- A AgBr
- B AgI
- C NaBr
- D NaI

(Total 1 mark)