Gateways School

**Redox & Group 2 & Group 7**

**Revision** **PPQ**

42 marks

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_**

**Q1.**

(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?

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**(1)**

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

(i)      NCl3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(ii)     Mg3N2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(iii)     NH2OH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(d)     Lead(IV) oxide, PbO2, reacts with concentrated hydrochloric acid to produce chlorine, lead(II) ions, Pb2+, and water.

(i)      Write a half-equation for the formation of Pb2+ and water from PbO2 in the presence of H+ ions.

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

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(iii)     Hence deduce an equation for the reaction which occurs when concentrated hydrochloric acid is added to lead(IV) oxide, PbO2

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**(3)**

**(Total 8 marks)**

**Q2.**

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 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(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.

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**(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.

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**(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.

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**(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)**

**Q3.**

Copper(II) sulfate solution, together with copper(II) carbonate (CuCO3) powder, can be used to determine the identity of three solutions **A, B** and **C**. The three solutions are known to be hydrochloric acid, barium chloride, and sodium chloride.

In **Experiment 1** a small amount of copper(II) carbonate powder was added to each of the three solutions.

In **Experiment 2** a dropping pipette was used to add 2 cm3 of copper(II) sulfate solution to each of the three solutions.

The results of these experiments are shown in the table below.

|  |  |  |
| --- | --- | --- |
|  | **Experiment 1** Addition of copper(II) carbonate powder | **Experiment 2** Addition of copper(II) sulfate solution |
| Solution **A** | no visible change | white precipitate |
| Solution **B** | no visible change | no visible change |
| Solution **C** | effervescence (bubbles of gas) | no visible change |

(a)     Use the observations in the table to deduce which of the solutions, **A, B** or **C** is

hydrochloric acid \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

barium chloride \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(b)     Explain why a precipitate was formed when copper(II) sulfate solution was added to solution **A**.
Write an equation for the reaction that occurred.

Explanation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Equation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)     Suggest the identity for the colourless gas produced when copper(II) carbonate powder was added to solution **C**.

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**(1)**

(d)     Identify the two reagents that could be used in a test to confirm that the solutions contained chloride ions, **not** bromide ions. State what would be observed on addition of each reagent.

Reagent 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observation 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Reagent 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observation 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(4)**

(e)     Copper(II) sulfate is toxic. Suggest **one** safety precaution you would take to minimise this hazard when wiping up a spillage of copper(II) sulfate solution.

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**(1)**

**(Total 10 marks)**

**Q4.**

A student investigated the chemistry of the halogens and the halide ions.

(a)     In the first two tests, the student made the following observations.

|  |  |
| --- | --- |
| **Test** | **Observation** |
| **1.** Add chlorine water to aqueous    potassium iodide solution. | The colourless solution turned abrown colour. |
| **2.** Add silver nitrate solution to aqueous    potassium chloride solution. | The colourless solution produced awhite precipitate. |

(i)      Identify the species responsible for the brown colour in Test **1**.

Write the **simplest ionic** equation for the reaction that has taken place in Test **1**.

State the type of reaction that has taken place in Test **1**.

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**(3)**

(ii)     Name the species responsible for the white precipitate in Test **2**.

Write the **simplest ionic** equation for the reaction that has taken place in Test **2**.

State what would be observed when an excess of dilute ammonia solution is added to the white precipitate obtained in Test **2**.

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**(3)**

(b)     In two further tests, the student made the following observations.

|  |  |
| --- | --- |
| **Test** | **Observation** |
| **3.** Add concentrated sulfuric acid to    solid potassium chloride. | The white solid produced mistywhite fumes which turnedblue litmus paper to red. |
| **4.** Add concentrated sulfuric acid to    solid potassium iodide. | The white solid turned black. A gaswas released that smelled of rotteneggs. A yellow solid was formed. |

(i)      Write the **simplest ionic** equation for the reaction that has taken place in Test **3**.

Identify the species responsible for the misty white fumes produced in Test **3**.

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**(2)**

(ii)     The student had read in a textbook that the equation for one of the reactions in Test **4** is as follows.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8H+ | + | 8I– | + | H2SO4 |   | 4I2 | + | H2S | + | 4H2O |

Write the **two** half-equations for this reaction.

State the role of the sulfuric acid and identify the yellow solid that is also observed in Test **4**.

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**(4)**

(iii)    The student knew that bromine can be used for killing microorganisms in swimming pool water.
The following equilibrium is established when bromine is added to cold water.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Br2(I) | + | H2O(I) |   | HBrO(aq) | + | H+(aq) | + | Br–(aq) |

Use Le Chatelier’s principle to explain why this equilibrium moves to the right when sodium hydroxide solution is added to a solution containing dissolved bromine.

Deduce why bromine can be used for killing microorganisms in swimming pool water, even though bromine is toxic.

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**(3)**

**(Total 15 marks)**

**Q5.**

Photochromic glass contains silver ions and copper ions. A simplified version of a redox equilibrium is shown below. In bright sunlight the high energy u.v. light causes silver atoms to form and the glass darkens. When the intensity of the light is reduced the reaction is reversed and the glass lightens.

Cu+(s) + Ag+(s)  Cu2+(s) + Ag(s)

clear glass                  dark glass

When the photochromic glass darkens

**A**       the Ag+ ion is acting as an electron donor.

**B**       the Cu+ ion is acting as a reducing agent.

**C**       the Ag+ ion is oxidised.

**D**       the Cu+ ion is reduced.

**(Total 1 mark)**

**Q6.**

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

**A**       1s2 2s2 2p5

**B**       1s2 2s2 2p6 3s2

**C**       1s2 2s2 2p6 3s2 3p5

**D**       1s2 2s2 2p6 3s2 3p6 4s2

**(Total 1 mark)**