"*No Co-ordination*"

YEAR 13 UNIT 5 TEST 5

5.5 REACTIONS OF INORGANIC COMPOUNDS IN SOLUTION

Answer all questions

Bonne Chance!

Name:…….

Mark for section A…… /33

Mark for section B…… /17

Total: ……. /50

Grade……..

SECTION A

1. (a) Vanadium(IV) chloride is a Lewis acid. Define the term *Lewis acid*.

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(1)

(b) When an aqueous solution of vanadium(III) chloride is treated with sodium carbonate, effervescence occurs and a precipitate forms. Deduce the formula of the gas and of the precipitate.

Formula of gas .....

Formula of precipitate .....

(2)
(Total 3 marks)

2. (a) (i) Explain what is meant by the term *amphoteric character*.

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(ii) Write two equations to illustrate that chromium(III) hydroxide is amphoteric.

Equation 1 .....

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Equation 1 .....

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(4)

(b) Ferrochrome is an alloy of iron and chromium.

Ferrochrome alloys dissolve in hydrochloric acid to give a solution containing iron (II) and chromium (III) ions. By stating the essential steps and reagents, plan an experiment to separate the iron (II) and chromium (III) ions in this solution so that you obtain a solution containing chromium (III) ions only.
Give the formula of the complex chromium(III) ions that your method produces.

Plan .....

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Formula of complex chromium(III) ion .....

(5)
(Total 9 marks)

3. (a) Complete the following electronic configurations. [Ar] represents the electronic configuration of the argon atom.

A copper atom [Ar] .....

A copper(II) ion [Ar] .....

(2)

(b) (i) When a few drops of aqueous ammonia are added to aqueous copper(II) sulphate, a pale blue precipitate forms. Give the name and formula of this precipitate.

Name .....

Formula .....

(2)

(ii) When a large excess of concentrated hydrochloric acid is added to aqueous copper(II) sulphate, the solution turns yellow. Explain what is happening during the addition of the acid, and give the formula and shape of the final copper-containing species in the solution.

Explanation .....

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Formula .....

Shape .....

(3)

(Total 7 marks)

4. Identify by formula each of the species labelled **A** to **I** in the reactions below.

(a) **A** is a metal which dissolves in concentrated hydrochloric acid to give a solution containing the blue species **B**. Dilution of this solution with water gives a solution containing the pink species **C**.

Formula of **A** .....

Formula of **B** .....

Formula of **C** .....

(3)

(b) **D** is a metal which dissolves in dilute nitric acid to give a colourless solution. This solution forms a white precipitate **E** when hydrochloric acid is added. Precipitate **E** dissolves in an excess of aqueous ammonia to form a solution containing the colourless species **F**.

Formula of **D** .....

Formula of **E** .....

Formula of **F** .....

(3)

(c) **G** is a metal which dissolves in hydrochloric acid in the presence of air to give a green solution. Treatment of this green solution with aqueous sodium hydroxide gives a green precipitate **H**. Precipitate **H** dissolves in an excess of aqueous sodium hydroxide to form a solution containing the green species **I**.

Formula of **G** .....

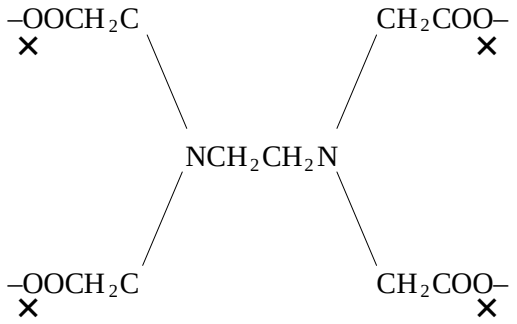
Formula of **H** .....

Formula of **I** .....

(3)

(Total 9 marks)

5. The multidentate ligand represented as $EDTA^{4-}$ has the structural formula shown below. Four of the atoms which can bond to a metal ion are marked with crosses.



(a) On the formula above, mark with crosses, two other atoms which bond to metal ions when $EDTA^{4-}$ forms complexes.

(1)

(b) $EDTA^{4-}$ is sometimes added to aqueous solutions of metal ions to prevent them forming precipitates in the presence of alkali.

(i) Give the colour and formula of the precipitate formed when aqueous sodium hydroxide is added to aqueous copper(II) sulphate.

Colour of precipitate.....

Formula of precipitate.....

(ii) Deduce why this precipitate does not form if an excess of $EDTA^{4-}$ is added to the aqueous copper(II) sulphate before the aqueous sodium hydroxide is added.

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(4)

(Total 5 marks)

SECTION B

6. (a) State what is observed when aqueous ammonia is added dropwise, until present in excess, to a solution of cobalt(II) chloride, and the mixture obtained is then left to stand in air. Give the formula of each cobalt-containing species formed. Explain the change which occurs when the mixture is left to stand in air.

(8)

(b) Explain why separate solutions of iron(II) sulphate and iron(III) sulphate of equal concentration have different pH values.
State what is observed when sodium carbonate is added separately to solutions of these two compounds. Give the formula of each iron-containing species formed.

(9)
(Total 17 marks)

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