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# CHEMISTRY

## INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	REACTIONS OF IONS IN AQUEOUS SOLUTION
PAPER TYPE:	QUESTION PAPER - 4
TOTAL QUESTIONS	10
TOTAL MARKS	44

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## Reactions of Ions in Aqueous Solution - 4

1. Aqueous solutions of copper(II) sulfate and cobalt(II) sulfate undergo ligand substitution reactions when treated separately with an excess of dilute aqueous ammonia.

Write equations for these reactions. Include the formulae for any complex ions.

Describe the changes that you would observe in each reaction.

(5)

2. This question is about test-tube reactions of some ions in aqueous solution.

For each reaction state the colour of the original solution.

State what you would observe after the named reagent has been added to the solution. In each case, write an equation for the reaction that occurs.

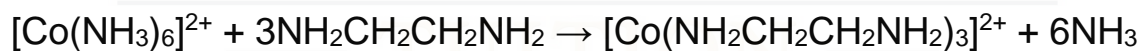
- (a) An excess of ammonia solution is added to a solution containing  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  ions.

(3)

(b) Sodium carbonate solution is added to a solution containing  $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$  ions.

(4)

3. Suggest why the enthalpy change for the following reaction is close to zero.



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(2)

4. State what is observed when an excess of aqueous ammonia reacts with an aqueous iron(II) salt.

Write an equation for this reaction.

(4)

5. This question is about metals.

(a) What is meant by amphoteric character of a metal hydroxide?

(2)

(b) Write two equations to show that aluminium hydroxide is amphoteric.

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(3)

6. Write the electron configurations for Cu and  $\text{Cu}^{2+}$ .

(2)

7. Describe what you would see, and give the formulae of the iron-containing or chromium-containing products formed, when

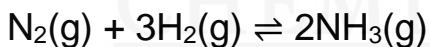
(a) Aqueous iron(III) chloride is treated with an excess of solid sodium carbonate.

(3)

(b) Aqueous chromium(III) sulphate is added to an excess of aqueous sodium hydroxide.

(3)

8. In the Haber Process for the manufacture of ammonia, the following equilibrium is established in the presence of a heterogeneous catalyst.



Identify the heterogeneous catalyst used in this process and state what is meant by the term heterogeneous.

A heterogeneous catalyst can become poisoned by impurities in the reactants.

Give one substance which poisons the heterogeneous catalyst used in the Haber Process and explain how this substance poisons the catalyst.

(5)

9. This question is about test-tube reactions of some ions in aqueous solution.

For each reaction state the colour of the original solution.

State what you would observe after the named reagent has been added to the solution.

In each case, write an equation for the reaction that occurs.

- (a) An excess of dilute sulfuric acid is added to a solution containing  $\text{CrO}_4^{2-}$  ions.

(3)

- (b) Sodium hydroxide solution is added to a solution containing  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  ions.

(3)

10. When CuCl is dissolved in an excess of concentrated hydrochloric acid, a colourless solution containing the complex ion,  $[\text{CuCl}_2]^-$ , is formed.

Give the oxidation state of copper in  $[\text{CuCl}_2]^-$ , give the electronic configuration of copper in this species and deduce why it is colourless.

(3)

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