Qualitative & Quantitative Analysis

Question Paper 2

Level	Pre U
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	Qualitative and quantitative analysis
Booklet	Question Paper 2

Time Allowed: **34 minutes**

Score: **/28**

Percentage: **/100**

Grade Boundaries:

1. Cyanide ions are used in the extraction of silver.

(a) The simple silver salt, AgCN, is an insoluble white solid.

(i) Draw a diagram of the cyanide ion, showing all the bonds, lone pairs and the ionic charge.

[2]

(ii) In Tollens' reagent, silver is present as the $Ag(NH_3)_2^+$ ion. Silver(I) also forms a soluble colourless ion with excess cyanide ions, $Ag(CN)_2^-$.

Write **ionic** equations for the precipitation of silver ions by cyanide ions and the subsequent dissolving of the precipitate in excess cyanide.

Include state symbols.

precipitation .....

dissolving ..... [2]

(iii) Describe what would be **observed** if a small volume of silver nitrate solution was added to an excess of aqueous sodium cyanide, followed by shaking the mixture.

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..... [2]

(b) Silver nitrate solutions used in analysis are usually prepared in very dilute acid solution.

(i) Suggest why silver nitrate is **not** prepared in an alkaline solution.

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..... [1]

(ii) Cyanide ions are normally used in alkaline conditions. Suggest why **acidification** of cyanide ions must be carried out with great care.

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..... [2]

(c) The concentration of cyanide ions in solution can be determined by titration against silver nitrate solution, $AgNO_3(aq)$. Initially $Ag(CN)_2^-(aq)$ is formed until silver ions are in excess, when a white precipitate of $Ag[Ag(CN)_2]$ forms. The appearance of this white precipitate indicates the end-point.

(i) What is the ratio of the number of moles of silver ions needed to reach the end-point to the initial number of moles of cyanide ions present in solution?

Ag^+ : CN^- = ... : .... [1]

(ii) It is advantageous to carry out the titration in the presence of aqueous ammonia and aqueous iodide ions.

$Ag[Ag(CN)_2]$ dissolves in ammonia, producing soluble $Ag(NH_3)_2^+$ ions. In the presence of aqueous iodide ions, insoluble $AgI(s)$ forms as a precipitate.

The volume of silver nitrate required in the titration is **not** affected, but the end-point precipitate is more distinctive.

What colour is the precipitate at the end-point when aqueous ammonia and iodide ions are present?

..... [1]

(iii) Which fact in the Qualitative Analysis Notes in the *Data Booklet* predicts the production of the precipitate in this titration?

..... [1]

(d) A sample bottle contains 1.00 g of a solid. This solid is thought to contain about 25% cyanide ions by mass. The solid is soluble in water.

You will be asked to plan a titration experiment to determine the exact mass of cyanide ions present in the sample.

Standard laboratory glassware and the following chemicals are available.

0.0500 mol dm^{-3} aqueous silver nitrate
0.2 mol dm^{-3} aqueous sodium iodide
2 mol dm^{-3} aqueous ammonia
deionised water

(i) Plan a titration experiment that would allow a chemist to make an accurate determination of the percentage by mass of cyanide ions in the given solid.

Your plan should include specific quantities that are supported by calculations.

Your plan should allow for repeat titrations.

There is no need to show how you will calculate the percentage by mass from your titration value.

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(ii) Assuming the 1.00 g sample analysed using your method contained 26.9% cyanide ions by mass, calculate the volume of silver nitrate expected in one of your titrations.

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..... [4]

[Total: 28]