OCR (B) Chemistry A-Level

PAG 04: Qualitative analysis of ions

4.2 Identifying unknowns 2

Equipment list

- Litmus paper
- Distilled water
- Measuring cylinder (25 cm^3)
- Beaker (100 cm^3)
- Conical flask (100 cm^3)
- Dropping pipettes
- Test-tube rack
- 4 x test-tubes
- Spatula
- Glass rod
- Bunsen burner
- Nitric acid (1 mol dm^{-3})
- Silver nitrate (0.05 mol dm^{-3})
- Aqueous barium chloride (0.2 mol dm^{-3})
- Aqueous sodium hydroxide (0.4 mol dm^{-3})
- Unknown solutions A-D

Method

You are given 4 solutions, labelled A, B, C and D
Find the identity of each solution, choosing from below:

- ➢ Sodium carbonate , Na_2CO_3 (aq)
- ➢ Ammonium chloride, NH_4Cl (aq)
- ➢ Sodium chloride, NaCl (aq)
- ➢ Sodium sulfate, Na_2SO_4 (aq)

1. Firstly add a sample of each solution to a different test tube.
2. Add nitric acid to each test tube. The solution that **effervesces** contains the carbonate ion and is hence Na_2CO_3 (aq).
3. Add Barium Nitrate to each remaining test tube. The solution that forms a **white precipitate** contains the sulfate ion and is hence Na_2SO_4 (aq).
4. Add silver nitrate to each of the last 2 remaining test tubes. The solutions should form **white precipitates** as they contain chloride ions (This step is unnecessary as if the previous steps have been carried out correctly then the remaining two solutions should be halide solutions- however you can choose to carry out this test, just to be sure)
5. To distinguish between NH_4Cl and NaCl, heat with sodium hydroxide and test the gas released with a **damp** piece of red litmus paper. For the solution containing ammonium ions, the litmus paper will go **blue**- this solution was NH_4Cl.

You can then write equations, both full and ionic for the reactions above, for example the reaction between NaCl and $AgNO_3$ is as follows:

Full equation: $NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$
Ionic equation: $Cl^-_{(aq)} + Ag^+_{(aq)} \rightarrow AgCl_{(s)}$

Risk Assessment

Hazard	Risk	Control
Solutions A-D	Treat all as irritant	Wear safety glasses, handle with care and place away from the edge of the desk.
Nitric acid, $HNO_3(aq)$, 1.0 mol dm^{-3}	Irritant to eyes, skin etc.	Wear safety glasses, handle with care and place away from the edge of the desk.
Silver nitrate, $AgNO_3(aq)$, 0.05 mol dm^{-3}	Solutions will cause staining.	Wear gloves, safety glasses and a lab coat. Keep away from the edge of surfaces
Aqueous barium chloride, $BaCl_2(aq)$ 0.2 mol dm^{-3}	Irritant- harmful if swallowed and irritates eyes, skin and lungs	Wear safety glasses, don't breathe in and handle with care
Aqueous sodium hydroxide, NaOH(aq) 0.4 mol dm^{-3}	Irritant	Wear safety glasses, handle with care and place away from the edge of the desk.

Errors

- Unexpected insoluble precipitates such as Ag_2SO_4, Ag_2CO_3 and $BaCO_3$ could form. Make sure you carry out the tests in the order above.
- False positive results may occur if slightly different chemicals are used. It is important to use the chemicals listed above i.e you don't want to use hydrochloric acid instead of nitric acid as that may cause a white precipitate to form later on in the experiment due to the presence of chloride ions that will react with silver nitrate.