Student 1: Low Excellence

Intended for teacher use only

Analysis of cation in Sample B:

Take 1mL of sample B and add 2 drops of NaOH solution. A blue precipitate forms. This eliminated Na^+ as no precipitate will have formed and also Fe^{2+}, Fe^{3+}, Mg^{2+}, Ba^{2+}, Zn^{2+}, Pb^{2+}, Al^{3+} as these would have formed precipitates of different colours.

$Cu^{2+}{}_{(aq)} + 2OH^-{}_{(aq)} \rightarrow Cu(OH)_{2\,(s)}$

The solubility rules state that all hydroxides are insoluble except potassium and sodium. This shows that copper hydroxide is insoluble and would make the precipitate I saw.

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Take a new sample of B, add 2 drops of NH_3/NH_4OH then add excess. A blue precipitate forms with the 2 drops which turns to a deep blue solution and the precipitates disappears in excess. This eliminates Ag^+ as this would have formed a brown precipitate, we can confirm the unknown cation in sample B is Cu^{2+}. Because the blue precipitate dissolved we know this is a complex ion once excess was added.

Equation for sample B and 2 drops of NH_3/NH_4OH

$Cu^{2+}{}_{(aq)} + 2OH^-{}_{(aq)} \rightarrow Cu(OH)_{2\,(s)}$

The solubility rules I talked about above are why this causes a precipitate too, copper hydroxide is insoluble so I saw a precipitate.

Equations for adding excess NH_3/NH_4OH

$Cu^{2+} + 4NH_3 \rightarrow [Cu(NH_3)_4]^{2+}{}_{(aq)}$

The precipitate of copper hydroxide dissolves because the Cu^{2+} cation in copper hydroxide formed a complex ion with the NH_3 which is soluble so the precipitate dissolved. 1

Significance of an identified species:

Copper enters drinking water mainly from corrosion of household plumbing and faucets. copper is commonly used in pipes of older houses. Older copper pipes tend to corrode which can cause a blueish stain in basins.
Acidic water in New Zealand can cause metals to dissolve. This reaction copper has with the water causes it to enter water supply. Another common way that copper contaminates our water is through metallic brake pads.
When brakes are activated in vehicles, fine particles of copper and other metals flake off and are deposited on roads. When these particles are washed away by rain, they enter stormwater systems where they are distributed into our rivers and lakes which is how higher amounts of copper enter our water supply. If a normal amount of copper is consumed by a (3)
human through food or water, it is generally non-toxic to humans. If too much copper is consumed such as accidental poisoning, the ion can cause vomiting or in some cases where a human is exposed to it in a workplace such as copper salts, can cause skin, eye, and lung irritation. Effects of the ion are heavily concentrated related and if copper is diluted side effects will be much less than that of higher concentrated consumption of copper. High (2)
amounts of copper in our natural water supply such as lakes and rivers can cause great damage to the aquatic life. it has very high toxicity for fish and other aquatic organisms as it is attracted to the gills of fish and quickly binds to them which stops it being able to effectively control water absorption. It is also highly toxic to algae and is commonly used as an algicide which is positive only in the case of an armful algal bloom. However, algae are an integral part of the aquatic ecosystem supplying food and habitat for aquatic organisms. Accidental killing of algae from copper getting into waterways is harmful to the aquatic life significantly.