

Title: Identifying an Unknown Cation

Purpose: To develop an experimental procedure based on chemical properties to identify the cations in an unknown solution.

“Before Lab” questions and information:

1. Filtration – using a filter to mechanically separate a mixtures
Decantation – carefully pouring off excess solution and leaving precipitate at the bottom
2. The precipitate must be washed to remove and excess solution to ensure only the pure precipitate remains
3. Yellow/Orange
4. Fe^{3+} - yellow
 Ni^{+2} – green
5. Color change, precipitation results, flame test color, and scheme of separation

Procedure: Spot tests were conducted on one drop of each known solution and the results were observed. NH_3 , DMG, $\text{K}_4\text{Fe}(\text{CN})_6$, K_2CrO_4 , HCl, NH_3 , and $(\text{NH}_4)_2\text{S}$ were used in the spot tests. The solutions were then flame tested and the color was noted. The precipitations were then tested to see if they would redissolve with the addition of hot water, NH_3 , and HNO_3 . A separation scheme was then devised to identify the metal ions using the observations from the spot tests. The scheme was tested with a solution known to contain all of the cations. The scheme was then conducted on two solutions with an unknown amount of cations.

Data Tables and graphs:

Table 1								
Spot Test Results								
Metal	NH₃	DMG	K₄Fe(CN)₆	K₂CrO₄	Flame	HCl	NH₃	(NH₄)₂S
Pb(NO ₃) ₂	White	No	White	Yellow	No	Yes	Yes	Black
Fe(NO ₃) ₃	Brown	Brown	Blue	Orange	No	No	Brown	Yes
AgNO ₃	No	No	White	Yellow	No	Yes	No	Yes
NiNO ₃	Blue	Pink	Green	Yellow	No	No	Blue	Yes
NaNO ₃	No	No	No	No	Orange	No	No	No

Table 2			
Redissolving Precipitates Formed with HCl			
Metal	Hot H₂O	NH₃	HNO₃
Pb	Yes	No	No
Ag	No	Yes	No

Table 3			
Redissolving Precipitates Formed with NH₃			
Metal	Hot H₂O	NH₃	HNO₃
Pb	No	No	Yes
Fe	No	No	Yes
Ni	No	Yes	No

Table 4			
Redissolving Precipitates Formed with $(\text{NH}_4)_2\text{S}$			
Metal	Hot H_2O	NH_3	HNO_3
Pb	No	No	Yes
Fe	No	No	Yes
Ag	No	No	No
Ni	No	No	No

Error Analysis: The amount of error in this experiment is low due to the lack of quantitative analysis. The only error could have come from incorrect observations or cross contamination of samples. If an observation was found to be incorrect, it would affect the entire flow scheme and make it almost impossible to find the correct ions. Some of the redissolutions were difficult to observe as well as some of the precipitations, but with repeated tests, the results are known.

Conclusions: Identifying an Unknown Cation showed us have to derive a flow chart to identify unknown cations by observing known reactions. Thus, it was determined that the unknown solution 4H-509 contained both Fe^{+3} and Na^{+1} .