

## CATION GROUP III – Part I

### PRELIMINARY TESTS – Reactions of Group III Cations

#### Introduction:

Reactions of Group III Cations with limited quantity of aqueous ammonia, excess aqueous ammonia, limited aqueous sodium hydroxide, excess aqueous sodium hydroxide, and excess aqueous sodium hydroxide plus hydrogen peroxide will be observed. The effect of an acetic acid/ acetate ion buffer on the chromate-dichromate equilibrium and the precipitation of chromate ion using barium cation will also be observed.

#### Materials Table:

**Safety:** **NICKEL (II) NITRATE** Harmful if swallowed or inhaled. Causes irritation to skin, eyes, and respiratory tract. May cause allergic skin or respiratory reaction. Can cause cancer.

**COBALT (II) NITRATE** May cause allergic respiratory reaction. May cause allergic skin reaction. May be harmful if swallowed. May cause cardiac disturbances. Causes eye and skin irritation. Causes digestive and respiratory tract irritation. May cause blood abnormalities

**POTASSIUM CHROMATE** Danger! May cause allergic respiratory reaction. Corrosive. Causes eye and skin burns. Causes digestive and respiratory tract burns. May cause cancer in humans

**Disposal:** Dispose of all reaction mixtures in the waste container labeled: Cation III Waste.

### Part A. Reactions of Group III Cations with Limited and Excess Aqueous Ammonia and Limited and Excess Aqueous Sodium Hydroxide Plus Hydrogen Peroxide

#### Procedure:

- Place four drops of each cation solution in separate labeled test tubes. (The cation solutions you will use contain either the nitrate or the chloride of the desired cation.) Add 1 drop of 6 M NH<sub>3</sub> solution to each tube. Record your observations in the table in your lab manual.
- To each of the mixtures, add 8-10 more drops of 6 M NH<sub>3</sub>. Record your observations. DISPOSE OF YOUR MIXTURES IN THE WASTE CONTAINER labeled "Group III cations."
- Place four drops of each cation solution in separate labeled test tubes. Add 1 drop of 6 M NaOH solution. Record your observations in the table in your lab manual.
- To each of the mixtures, add 12 more drops of 6 M NaOH. Record your observations.

- e. To each of the mixtures, add 6-8 drops of 3 % H<sub>2</sub>O<sub>2</sub> solution and heat them in a hot water bath for a few minutes. Record your observations. DISPOSE OF YOUR MIXTURES IN THE WASTE CONTAINER labeled "Group III cations."
- f. Write a *NET IONIC EQUATION* for each reaction that occurs. Write the equations in your lab manual, following the observation/data table. Be sure to label each set of equations, for example:
- (a) *Reactions with Limited NH<sub>3</sub>*  
 (b) *Reactions with Excess NH<sub>3</sub> and ..... etc.*

### Observation/Data Table:

On a new page, copy the table below onto a new page in your lab manual and **record your observations in the table in your** lab manual.

Cation	Concentration of cations	Initial Color of Solution	(a) Limited NH <sub>3</sub>	(b) Excess NH <sub>3</sub>	(c) Limited NaOH	(d) Excess NaOH	(e) Excess NaOH & H <sub>2</sub> O <sub>2</sub>
Fe <sup>3+</sup>	48.2 g/L FeCl <sub>3</sub>						
Al <sup>3+</sup>	90.0 g/L AlCl <sub>3</sub>						
Co <sup>2+</sup>	50.0 g/L Co(NO <sub>3</sub> ) <sub>2</sub>						
Ni <sup>2+</sup>	50.0 g/L Ni(NO <sub>3</sub> ) <sub>2</sub>						
Mn <sup>2+</sup>	36.0 g/L MnCl <sub>2</sub>						
Zn <sup>2+</sup>	45.6 g/L Zn(NO <sub>3</sub> ) <sub>2</sub>						
Cr <sup>3+</sup>	51.0 g/L CrCl <sub>3</sub>						

## Part B. Chromate-Dichromate Equilibrium

### PROCEDURE:

1. Place 5 drops of 0.5 M  $\text{K}_2\text{CrO}_4$  solution and 5 drops of water in a test tube. Add a few drops of 6 M  $\text{HNO}_3$  solution to make the mixture acidic. A product of the reaction that occurs is  $\text{Cr}_2\text{O}_7^{2-}$ . Record your observations in your laboratory manual and write the NET IONIC EQUATION for the reaction that occurs. (Hint: It is an equilibrium equation!)
2. To the mixture add concentrated aqueous  $\text{NH}_3$  dropwise until the solution is basic. Add a small (pea size) amount of  $\text{NaC}_2\text{H}_3\text{O}_2$  and add 6 M acetic acid until the solution is just acidic. Add 5 drops, or enough 120 g/L  $\text{BaCl}_2$  so that precipitation is complete. Record your observations in your lab manual. DISPOSE OF THE MIXTURE IN THE WASTE CONTAINER labeled "Group III cations." Write the NET IONIC EQUATION for the reaction in your lab manual.

SUMMARY: Write a summary, summarizing your results.