

Demo
Complex Ion Reactions

Name _____

Purpose: To observe reactions involving metal ions complexed with Lewis base ligands.

General concepts:

- **General Rule:** *The number of ligands will often be twice the charge on the metal ion.*
- Metal ions in water always form the hexa-aquo complex in the absence of stronger ligands.
(Yes, when water is a ligand, the previous general rule often does not hold.)
- Complex ions can be identified by their colors

Part A: Reactions involving Cu^{2+} solutions

1) **Ligand Exchange:** Rxn: Copper (II) sulfate is reacted with concentrated HCl (or NaCl)

Molecular Equation:

Net Ionic Equation:

Label Colors

2) **Formation of a precipitate:** Rxn: Copper(II) sulfate is reacted with dilute NH_3
Hint: NH_3 is a weak base. Thus, $\text{NH}_3(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{NH}_4^+(aq) + \text{OH}^-(aq)$

Molecular Equation:

Net Ionic Equation:

Label Colors

3) **Dissolution of a precipitate by forming a complex ion :**
Rxn: Copper (II) hydroxide solid is reacted with excess ammonia solution.

Molecular Equation:

Net Ionic Equation:

Label Colors

4) ~~**Dissolution of an ammine complex ion by adding acid:**~~
Rxn: Tetraammine copper (II)sulfate, $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$, is reacted with concentrated nitric acid.

~~*Molecular Equation:*~~

~~*Net Ionic Equation:* _____~~

~~*Label Colors*~~

5) ~~**Formation of a thiocyanato complex (Adding SCN^-)**~~
Rxn: Copper (II) sulfate is reacted with excess potassium thiocyanate solution.

~~*Molecular Equation:*~~

~~*Net Ionic Equation:* _____~~

~~*Label Colors*~~

Part B: System involving Fe³⁺ solutions

- 6) ~~Formation of thiocyanato complex using dilute thiocyanate solution~~

~~Rxn: Iron (III)nitrate is reacted with dilute potassium thiocyanate.~~

~~Molecular Equation:~~

~~Net Ionic Equation: _____~~

~~Label Colors~~

- 7) ~~Formation of thiocyanato complex using excess thiocyanate solution~~

~~Rxn: Iron(III)nitrate is reacted with excess potassium thiocyanate~~

~~Molecular Equation:~~

~~Net Ionic Equation: _____~~

~~Label Colors~~

Part C: Reactions involving Al³⁺

- 8) **Formation of a precipitate using dilute NaOH**

Rxn: Aluminum nitrate is reacted with dilute sodium hydroxide

Molecular Equation:

Net Ionic Equation:

Label Colors

- 9) **Dissolution of a precipitate by forming a complex ion:**

Rxn: Aluminum nitrate is reacted with excess sodium hydroxide

Molecular Equation:

Net Ionic Equation:

Label Colors

Part D: Reactions involving Co²⁺

- 10) **Ligand Exchange**

Rxn: Cobalt(II)nitrate is reacted with concentrated hydrochloric acid

Molecular Equation:

Net Ionic Equation: _____

Label Colors