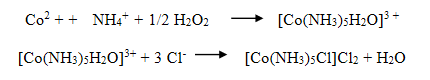
**CH 412 LA: INORGANIC CHEMISTRY LABORATORY (Spring 2021)**

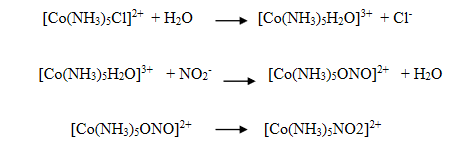
**Title:**

1. **Purpose: (1 point)**

**The purpose of this experiment is to demonstrate coordination complexes through the preparation of chloropentaaminecobalt(III) chloride and nitropentaaminecobalt(III) chloride.**

1. **Drawing of structure of the main compound or balanced chemical equation if synthesis is performed: (1 point)**





**3. Reagents and the major product (up to 5 points)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Name** | **M.W.**  (0.5 pts) | **Density**  (0.5 pts) | **Amount (grams/mL)**  (0.5 pts) | **Moles**  (0.5 pts) | **Hazards/Precautions**  **(MSDS data) and melting point or boiling point** (2 pts) | **Role of the reagent** (1 pts)\* |
| Ammonium chloride | 53.49 | 1.53 g/cm3 | 5.0 grams | 0.0935 | Harmful if swallowed. Causes eye irritation.  MP: 328°C  BP: 520°C | Reactant |
| Ammonia | 17.031 | 0.91 g/cm3 | 30 mL | 1.602 | Toxic if inhaled. Causes burns by all exposure routes. Harmful if swallowed.  MP: -69°C  BP: 27°C | Reactant |
| Cobalt (II) chloride hexahydrate | 237.92 | 1.924 g/cm3 | 10 grams | 0.042 | Causes irritation and possible burns by all routes of exposure.  MP: 87°C  BP: 1048.9°C | Reactant |
| Hydrogen peroxide | 34.015 | 1.11 g/cm3 | 8 mL | 0.261 | Strong oxidizer, harmful if swallowed. Causes severe skin burns and eye damage.  MP: -0.41°C  BP: 150.2°C | Reactant |
| Hydrochloric acid (solution) | 36.46 | 1.19 g/cm3 (38%) | -- | -- | Causes eye and skin burns. Causes digestive and respiratory tract burns.  MP: -66°C  BP: 83°C | Reactant |
| Sodium nitrite | 69 | 2.168 g/cm3 | 5.0 grams | 0.0725 | May be fatal if inhaled. Strong oxidizer. Causes eye, skin, and respiratory tract irritation.  MP: 271°C  BP: 320°C | Reactant |
| Chloropentaaminecobalt(III) chloride | 250.44 | 1.783 g/cm3 | -- | -- | May cause skin irritation. Suspected of causing cancer. | Product |
| Nitropentaaminecobalt(III) chloride | 261 | 1.83 g/cm3 | -- | -- | No data | Product |
| Nitritopentaaminecobalt(III) chloride | 261 | -- | -- | -- | No data | Product |

**\*** Mention role as either reactant, solvent, catalyst or product

1. **Calculations: (1 point) (ignore it)**

Show each calculation for moles of reagents and for theoretical and actual yield. Fill in the box with the limiting reagent and theoretical yield:

The limiting reagent is

The theoretical yield is

**5. Procedure (up to 2 points)**

|  |  |
| --- | --- |
| **Procedure** | **Observations and Lab Data** |
| A summary of the procedure done with bullet points) | Color changes, exothermic or endothermic reactions, gas generation, etc.; tare weights for flasks, etc. |
| Part 1   * Make a solution with 5.0 g ammonium chloride in 30 mL of concentrated ammonia in a 250 mL Erlenmeyer flask. * Place this flask on a magnetic stirrer hot plate, add stir bar, and turn on stirring. * While stirring, add 10 g of finely powdered cobalt (II) chloride hexahydrate. * While still stirring, add dropwise 8 mL 30% hydrogen peroxide. * When evidence of reaction has ceased (no color change or gas evolution) slowly add 30 mL of concentrated HCl. * While continuing to stir, turn on hot plate and adjust temperature to 85°C using a surface thermometer on top of hot plate. * Heat for 20 minutes. * Cool mixture to room temperature and filter precipitated [CO(NH­3)5Cl]Cl2 with a medium porosity sintered glass funnel. * Wash the purple crystals with several portions of ice water, not exceeding 20 mL. * Wash with about 20 mL of 6M HCl and dry in 100°C oven for 2 hours.   Part 2   * Start to heat solution of 8 mL of concentrated ammonia in 80 mL of water on stirrer hot plate. * While heating and stirring, add 5.0 g of [CO(NH­3)5Cl]Cl2. * Continue stirring until colored product dissolves. Filter off any dark brown or black cobalt oxide. * Cool the filtrate to about 10°C. Add 2M HCl slowly while it is still cold until it is neutral with a litmus test. * Add 5.0 g sodium nitrate followed by 5 mL 6M HCl. * After solution has been in an ice bath, filter precipitated salmon pink crystals of [Co(NH3)5ONO]Cl2 with vacuum filtration. * Wash with 25 mL ice water, 25 mL alcohol, and then allow it to dry on the lab bench for one hour.   Part 3   * Bring 20 mL of water to a boil, add a few drops of aqueous ammonia, and add 2.0 g of [Co(NH3)5ONO]Cl2. * As the solution cools, add 20 mL of concentrated HCl. * When it fully cools, the [Co(NH3)5NO2]Cl2­ will crystallize from the solution. * Filter the product with a Buchner funnel and vacuum filtration. * Wash product with 13 mL of alcohol, and allow it to dry in air for two hours. |  |

**6.** Results; include actual yield in grams and % yield.

**Results (need to get signed by instructor or TA):**