Name:_____ Section_____

Chemistry 104 Laboratory
University of Massachusetts Boston

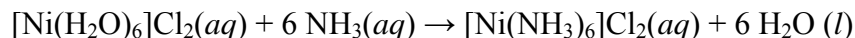# Hexamminenickel(II) Chloride Synthesis
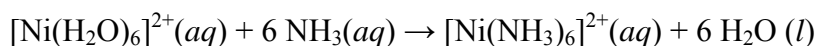
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PRELAB ASSIGNMENT

Calculate the percent yield for the sample data shown on page 3.   Answer_____

_____

INTRODUCTION

In aqueous solution nickel ion Ni^{2+} is surrounded by six water molecules which are actually bonded to the central metal ion. This complex is called the hexaquonickel(II) ion. When aqueous nickel chloride is precipitated from solution, the nickel ions carry their six water molecules into the crystals and so solid nickel(II) chloride is hydrated, has the formula $[Ni(H_2O)_6]Cl_2$, and is more properly called hexaquonickel(II) chloride. If ammonia is added to a solution of this salt, ammonia molecules compete with the water in bonding Ni^{2+} and because the ammonia forms a stronger bond than water, the ammonia replaces the water according to:

$$[Ni(H_2O)_6]Cl_2(aq) + 6\ NH_3(aq) \rightarrow [Ni(NH_3)_6]Cl_2(aq) + 6\ H_2O\ (l)$$

or, as a net ionic equation

$$[Ni(H_2O)_6]^{2+}(aq) + 6\ NH_3(aq) \rightarrow [Ni(NH_3)_6]^{2+}(aq) + 6\ H_2O\ (l)$$

In this net ionic equation, the product $[Ni(NH_3)_6]^{2+}$ is called hexamminenickel(II) ion.

In this experiment we will synthesize the complex salt hexamminenickel(II) chloride. In the next experiment we will analyze for the percent ammonia in this salt.

IN THE LABORATORY

1) Use an analytical balance to tare a weighing dish and then weigh out anywhere from 4.0 to 4.5 g of nickel chloride. Record the mass to a tenth of a milligram on the data sheet.

2) Dissolve your nickel chloride in roughly 10 mL of deionized water in a 250-mL beaker. Mark the beaker with your initials.

3) Slowly pour aqueous ammonia into your beaker up to the 50-mL line. Stir with a glass rod. After 15 minutes, cool in an ice bath stirring occasionally.

Hexamminenickel(II) Chloride Synthesis

Go to a fume hood for the next step.
Do not smell or touch the aqueous ammonia solution.
Do not remove your beaker from the hood until the next step is completed.

4) Pour about 10 mL of aqueous ammonia into an Erlenmeyer flask and set this in the ice to use in Step 6.

After about 20 minutes, ask your instructor to check that you have enough crystals. Meanwhile, work on the AMMONIA ANALYSIS PRACTICE part of page 4.

5) Filter the crystals through filter paper in a Buchner funnel using a suction filtration apparatus.

6) Wash the crystals in two stages, first with ice-cold aqueous ammonia, and then with about 10 mL of ethanol. The procedure for both stages is:
   - Shut off the vacuum.
   - Add the wash liquid (cold aqueous ammonia or ethanol).
   - Use the spatula to move the crystals around gently in the wash.
   - Turn on the vacuum to draw down the wash liquid.

7) Air-dry the crystals on the filter paper by continuing to draw air through them with the vacuum for 15 minutes.

8) On an analytical balance, weigh an empty vial with cap on. Transfer the dry crystals to the vial and reweigh. Label the vial with your name and give it to your lab instructor for safe keeping until next session.

CALCULATIONS

Calculate the actual yield, which is the mass of your crystals.

Calculate the theoretical yield, which is the mass of $[Ni(NH_3)_6]Cl_2$ produced assuming that all of your $[Ni(H_2O)_6]Cl_2$ was converted.

Calculate the percent yield, which is (actual yield/theoretical yield) x 100%.

In preparation for the next experiment, fill in all the blanks in the AMMONIA ANALYSIS SAMPLE CALCULATION. Ask your instructor for any help in understanding the experiment.

Hand in your prelab exercise, synthesis data sheet, and practice calculations before leaving.

Hexamminenickel(II) Chloride Synthesis

Name:_____ Section_____

Partner's name _____

SAMPLE DATA FOR SYNTHESIS PRELAB EXERCISE

Step 1.   Mass of $[Ni(H_2O)_6]Cl_2$ 4.1812 g

Step 8.   Mass of vial   Empty 10.5900 g   With crystals 12.1261 g

Mass of $[Ni(NH_3)_6]Cl_2$ (Actual yield)   _____

Theoretical yield   _____

Percent Yield   _____

SYNTHESIS DATA SHEET AND REPORT

Step 1.   Mass of $[Ni(H_2O)_6]Cl_2$ _____

Step 8.   Mass of vial   Empty _____   With crystals _____

Mass of $[Ni(NH_3)_6]Cl_2$ (Actual yield)   _____

Theoretical yield   _____

Percent Yield   _____

Hexamminenickel(II) Chloride Synthesis

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AMMONIA ANALYSIS PRACTICE CALCULATION

Please refer to the instructions for details of the Analysis experiment.

Sample	A	B	C
1. Mass of solid	0.1260	0.1358	0.1375 g
3. Molarity of HCl added by 25.00 mL pipet,		$C_a = 0.1515$ M	
Millimoles of HCl added by $V_a = 25.00$ mL pipet		$V_a C_a =$ _____	
5. Molarity of NaOH in the buret		$C_b = 0.1815$ M	

6. and 7. Titrations	A	B	C
Initial reading	0.10	0.05	0.50 mL
Final reading	17.76	14.22	15.02 mL
Endpoint volumes, V_b	_____	_____	_____
8. mmoles of NaOH in V_b	_____	_____	_____
9. mmoles NH_3 reacted	_____	_____	_____
10. Mass of NH_3 reacted	_____	_____	_____
11. Percent NH_3 by mass	_____	_____	_____
12. Mean percent NH_3		_____	