

# How was Experiment 6 Graded?

Chem 151 Fall 2009

## III.A. Synthesis of Hexaamminecobalt(III) chloride (22 points possible)

2 pts. were awarded for the correct calculation of the number of moles of  $\text{NH}_4\text{Cl}$  added.

2 pts. were awarded for the correct calculation of the number of moles of  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$  added.

6 pts. were awarded for the correct calculation of the number of moles of  $\text{H}_2\text{O}_2$  used.

*See pre-lab practice 6 for the calculation of moles of  $\text{H}_2\text{O}_2$ .*

6 pts. were awarded for the correct calculation of the theoretical yield of  $\text{Co}(\text{NH}_3)_6\text{Cl}_3$  produced.

*From the reaction equation:*



*For example, a student used 0.1039 g of  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ , which is  $4.37 \times 10^{-4}$  moles of  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ ; theoretically,  $4.37 \times 10^{-4}$  moles of  $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$  can be produced. The theoretical yield in grams of product produced is:*

$$4.37 \times 10^{-4} \text{ mol} (267.3 \text{ g/mol}) = 0.117 \text{ g (Theoretical yield)}$$

2 pts. were awarded for the correct calculation of the percentage yield of the synthesis procedure.

2 pts. were awarded for circling Jack's yield is same as Jill's because  $\text{H}_2\text{O}_2$  is the exceed reagent in both.

2 pts. were awarded for circling Joe's yield is smaller than Jane's because  $\text{H}_2\text{O}_2$  in Joe's experiment became the limiting reagent.

## III.B. Synthesis of Tetraamminecopper(II) Sulfate Monohydrate (8 points possible)

6 pts. were awarded for the correct calculation of Question 9

*Moles of  $\text{Cu}^{2+}$  in 1.0 mL saturated  $\text{CuSO}_4$  solution:  
(0.90 mol/L)(0.0010 L) =  $9.0 \times 10^{-4}$  mol*

*moles of  $\text{Cu}(\text{NH}_3)_4\text{SO}_4 \cdot \text{H}_2\text{O}$  can be produced is  $9.0 \times 10^{-4}$  mol*

*Mass of  $\text{Cu}(\text{NH}_3)_4\text{SO}_4 \cdot \text{H}_2\text{O}$  can be produced:  
( $9.0 \times 10^{-4}$  mol)(245.61 g/mol) = 0.22 g*

2 pts. were awarded for the correct calculation of the percentage yield of  $\text{Cu}(\text{NH}_3)_4\text{SO}_4 \cdot \text{H}_2\text{O}$

## III.C. Finding $\lambda_{\text{max}}$ for the Complex Ions (32 points possible)

4 pts. were awarded for each correct color and prediction of  $\lambda_{\text{max}}$  of  $\text{Co}(\text{NH}_3)_6^{3+}$ ,  $\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2^{2+}$  and  $\text{Cu}(\text{H}_2\text{O})_6^{2+}$  within the acceptable range.

4 pts. were awarded for each correct spectrum of the complex ion. No credit was awarded if the spectra were switched.

2 pts. were awarded for entering  $\text{Cu}(\text{OH})_2$  as the formula of the precipitate in Question 14.

6 pts. were awarded for the quality of two synthetic products.

## Complete and Organized Notebook pages (10 points possible)

- Does the record in your notebook pages provide you with sufficient information to write your report?
- Are your notebook records clear enough to another experimenter repeat/ understand your work?

## Prelab Assignment (10 points possible)

## PREPARATION AND SPECTROSCOPY OF COMPLEX IONS

1. Circle all the labile complexes listed below:

2 pts.



*Co(II) complexes are labile, Co(III) complexes are inert.*

2. Write a balanced reaction equation to illustrate the reaction that takes place in Steps 5 and 6.

2 pts.

*Remember the equilibrium of  $\text{NH}_4\text{OH}$  in aqueous solution:*



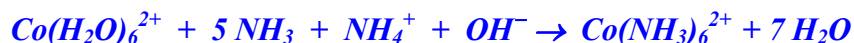
1. *Addition of  $\text{NH}_4\text{Cl}$  shift the equilibrium further to the right*



2. *The  $\text{NH}_3$  in solution (which comes from the equilibrium of  $\text{NH}_4\text{OH}$  and from the reaction of  $\text{NH}_4^+$  with  $\text{OH}^-$ ) substitute the aqua ligand in the hexaaquacobalt(II) complex*



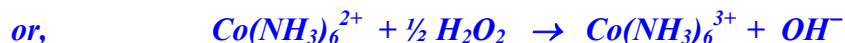
*Combining the above two equations to obtain:*



3. Write a balanced reaction equation to illustrate the reaction that takes place in Steps 7 and 8.

2 pts.

*The hexaamminecobalt(II) complex is oxidized by  $\text{H}_2\text{O}_2$  to become hexaamminecobalt(III) complex in basic medium (due to the presence of  $\text{NH}_4\text{OH}$ ).*



*Combining the equations in Questions 3 and 4 gives the net ionic equation given in the lab manual.*

