17 August 2025

Complete the entries as indicated. Any writing in green must be deleted in your version.   
As the term progresses, there will be less structure provided for you to use in your report writing. By then, you will have had feedback from one or two markers and it is expected that you can create that structure for yourself, as part of the learning process. There is no single format that is correct and all others wrong. The best guide is to aim for a clear report on your work that can be understood by someone who is not familiar with the experiment.

Name: Section #:

Date(s) experiment carried out:

**Experiment E2: The Oxidation States of Cobalt**

**Abstract**

In this experiment, two analogues of cobalt(II) complexes were prepared with ligands 2,2’-bipyridyl and 1,10-phenanthroline. Each was oxidized to the corresponding cobalt(III) species with elemental bromine. Magnetic susceptibility measurements were taken to establish the arrangement of electrons at the metal centre of each product.

**Balanced equation(s**) (5 marks)

Give the fully balanced equation(s) of all four reactions. Where appropriate, give the equations for each procedural step. Draw the structures of the non-trivial products.

**Tables 1 & 2: Reagents and Table 3: Products** (these may be combined into one table if you prefer, or one table each for the reagents + products for each reaction)(3 marks)

Edit the Excel file of starting materials (given on the course web site) to generate a table of reagents for each procedural step that you performed.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reagent | Mass (g) or volume used (mL) | MW | # mmoles | Relevant physical properties; safety data; indicate Limiting Reagent. |
|  |  |  |  |  |
|  |  |  |  |  |

Number your table and give it a title.

Similarly, create a table for the products that you made. For example …

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Product | Mass (g) | MW | # mmoles | % yield\* | Observations and/or physical properties. |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

\*Give sample calculations below.

**Table 4: Magnetic susceptibility data** (3 marks)

Tabulate the data collected by you, with calculations explained.

|  |  |  |
| --- | --- | --- |
| Your sample (edit accordingly) | [Co(bipy)3]Br2 or [Co(phen)3]Br2 | [Co(bipy)3]Br3 or [Co(phen)3]Br3 |
| *mo* (g) |  |  |
| *m* (g) |  |  |
| *Ro* |  |  |
| *R* |  |  |
| length (cm) |  |  |
| temperature (oC) |  |  |
| χg = *{CBal⋅ l⋅ (R-Ro)}/{(m - mo) x109}*  where CBal = 1.083  note: if *R-Ro* is close to zero or negative, do not continue with the calculations and report n = 0. |  |  |
| MW |  |  |
| χ m = χg x mol. wt. |  |  |
| diamagnetic corrections (total) |  |  |
| χA = χ m + diamagnetic corrections |  |  |
| temp (K) |  |  |
| μeff = 2.828√(χAT) where T = temp in Kelvin |  |  |
| n = # unpaired electrons  (nearest integer) |  |  |

**Table 5: Summary of group product data with % yields** (1 mark)

**Table 6: Summary table of group magnetic susceptibility data and results** (2 marks)

**Procedure** (1 mark)

The procedure was followed as given. 1

No further experimental details need be added unless necessary, but do give any pertinent observations here.

**Discussion** (7 marks)

This is the section where you can add intellectual value to the quality of the report. Resist the temptation to repeat the data tables in words. Try to comment on the results of the syntheses, the variations noted and offer plausible reasons for trends and anomalies. Remember to use your data, and the data of your group, as evidence for your comments. Do the same for magnetic susceptibility data and results. Explain the differences between diamagnetism and paramagnetism. Diagrams can help explain a lot and are not included in the word count. Did the results match up with what was expected from a theoretical approach? There is a 1200 maximum word limit on this section.

**Conclusion** (0.5 mark)

Give a brief statement of what this experiment proved, or failed to prove.

**References** (0.5 mark)

1. Chem260 Laboratory Manual, University of Victoria, 2025/2026.
2. List other references here, but only if you used them in your writing. Do not search for references beyond those given in the manual.

Appropriate editing and formatting of report (1 mark)