Name:_____ Experiment:_____ Points:_____/100

Each section is marked on a finite numerical scale, ranging from excellent (top), to unacceptable (bottom), with missing = 0. Particular criteria needing work are highlighted. The most important criteria are in italics.

Format — Points ___/5

- **Expansion report** cover is used. Different lab reports are separated by **notebook dividers**
- **Original in-class notes**, not recopies, are provided, with handwritten notes on **engineering paper**.
- Contents are in **correct order**: in-class notes followed by analysis section, ending with written section

Record Keeping — Points ___/30

In-class notes (5 pts.) 5 4 3 2 1 0

- *Notes are **easy to follow**: an outsider could tell what was being recorded and why.*
- *Notes are **complete**: operations or conditions that affect the interpretation or analysis of data are given.*
- **First page** includes **name of experiment**, names of **all partners**, and **dates** beginning and ending experiment.
- Each page is **numbered** and **dated**.
- Notes are **neatly kept** and are recorded in **pen**.

Apparatus diagrams and annotations (10 pts.) 10 8 6 4 2 0

- *The diagrams + annotations **succeed** in communicating **how the apparatus works** and **how it was used**.*
- *Diagrams are **functionally clear**: the diagrams would make sense to other students in the course.*
- *Diagrams are **correct** and **well annotated**, indicating the **use** and/or **function of each important component** and **sub-component**, clear **signal paths**, and **important physical features** (e.g. magnet orientation, important dimensions).*
- Diagrams are **original drawings** taken from the apparatus itself, not merely copied from the instructions.

Data (15 pts.) 15 13 11 9 7 5 3 1 0

- *Raw data are **correct**: no significant mistakes in collection of data. [Note – you should annotate corrected mistakes]*
- *The data set is **sufficient** to calculate **all important results** and **random uncertainty**.*
- *Relevant **conditions pertaining to data** sets (e.g., sample type, run number, equipment settings) are present.*
- **Tables of data** include an **estimate of uncertainty** along with **reasons for assigning that uncertainty**.
- Raw data are **recorded neatly**, with **correct units.**
- **Copies** of original data (XY plots, computer printouts, tables, etc.) are **complete** and **annotated with information** describing the sample, conditions or other information pertaining to it.

Analysis and Results — Points ___/40

Analysis of data (15 pts) 15 13 11 9 7 5 3 1 0

- ***All data** taken are **analyzed**.*
- *Analysis of data is **correct.***
- ***Plotting and fitting** of data to obtain results **is used** when appropriate.*
- ***All calculations** performed, in whatever manner (spreadsheets, code, by hand), are **fully** and **clearly** described with **annotations**.*
- **Graphs** are at least **1/2 page** in size and **easy to read:** one could estimate data points from the graph itself.
- **Graphs follow these basic formatting conventions: Legends** are given for graphs with multiple data sets and/or curves; **data points** are **bare**—point symbols **not connected** with lines; when applicable points include **error bars**; theoretical **curves** and/or **fits** are shown as **lines** (not points); **axes** are labeled with **quantity** and correct **units**; there is a clear **title** explaining the graph's purpose.
- Spreadsheet **printouts** are **clearly laid out** with **labeled** columns and rows, including **quantities** and **units**.
- Computer **code** (Matlab, Mathematica, IDL, etc.), if used, is printed out and **included**.
- **Formulas** that are used are written **near relevant parts** of the report, with all variables either obvious (i.e., standard constants) or **defined**.

Uncertainty analysis and calculation (10 pts.) 10 8 6 4 2 0

- ***Uncertainty** is calculated for numerical results.*
- ***Reasoning** and **method** used to derive uncertainty in final results is **clearly presented** and **correctly applied**.*
- Uncertainty **calculations** themselves are clearly shown (either in entirety or with examples).

Final results: assessment and presentation & Solutions to exercises (15 pts.) 15 13 11 9 7 5 3 1 0

- ***Final results** are **critically evaluated** within the **notes**: e.g., different results are compared to each other, noting trends or patterns; results are compared to literature or expected values and agreement is discussed.*
- ***Evidence**, or lack thereof, for **systematic error** is noted and described in the notes.*
- ***Solutions** to all **exercises** are present and correct;* they are **commented on**: *significance to experiment is discussed.* NOTE: exercises are found both in the main experimental instructions and on the course website.
- **Numerical results** are clearly stated in the notes with **correct format, units, significant digits** and **uncertainty**.
- **Sources for literature** values are **cited** in sufficient detail.

Name:_____Experiment:_____Points:_____/100

Summary Abstract (Roughly one page, single spaced) Points ___/15

General (2 pts.) 2 1 0

- *Overall, it is **clear** that the **writer understands** the experiment.*
- **Writing** is **clear** and logically structured.
- **English** is **correct** in terms of spelling, grammar, word choice and usage.
- **Style** of writing follows conventions **appropriate** to a scientific **journal**.

First paragraph - Statement of purpose (3 pts.) 3 2 1 0

- *First sentence (or two) states the **purpose** of the experiment in a **general way**.*
- *The statement of purpose **highlights** the **essential physics** studied by the experiment.*
- *The statement of purpose **names** the **central technique** used in the experiment (e.g., pulsed nuclear magnetic resonance).*
- The statement would be **easily understood** to **other students** in the course.
- **Phrases** such as "The purpose of this experiment...", or "In this lab, we..." are **avoided**.

Second paragraph - Method (4 pts.) 4 3 2 1 0

- *The **method** is described in a **general way**.*
- *The description **clearly indicates** the **chain of cause and effect**: how the experiment works.*
- **Trivial details** that have no bearing on the interpretation of the results **are omitted**.
- **Important conditions** that would affect the **interpretation and understanding** of the results **are included**.

Third paragraph - Results (3 pts.) 2 1 0

- *The statement of results is **complete.***
- *The statement of results is **correct.***
- **Numerical results** are presented with correct **units** and **format.**
- **Numerical results** are presented with correct **significant digits** and **uncertainty**.

Final paragraph(s) - Assessment/Discussion (4 pts) 4 3 2 1 0

- *The discussion is **complete:** all results are assessed in sufficient depth.*
- *The **discussion** is **correct:** arguments made are based on sound physical reasoning.*
- *When possible, **Results** are compared to **literature**.*
- **Different results** within the experiment are **compared to each other** and **interpreted**.
- The **discussion** would be easily understood by **other students** in the course.
- **Literature comparisons** are made **correctly**.
- If they exist, systematic **trends** are adequately **noted** and **interpreted**.
- Evidence of systematic error, or lack thereof, is adequately noted and described.

Discussion of Uncertainty Points ___/10

Overall, the discussion of uncertainty is clear. (3 pts.) 3 2 1 0

- **State the uncertainty** in the important quantities, either by magnitude or percentage.
- **List the most important contributors** to the uncertainties along with **reasons** for the size of their contribution.
- **Note any disagreement** between measured and expected results and present **argument** for this disagreement.

The uncertainty discussion is consistent with the data and analysis portion of the report. (1 pt.) 1 0

- **No new sources** of uncertainty should be **introduced** in the discussion.

The discussion correctly distinguishes between systematic and random uncertainty. (2 pts.) 2 1 0

- Unless otherwise stated, all quoted uncertainties are assumed to be random.
- Disagreements between expected and calculated results are, by definition, due to systematic error.

The sources (that is, causes) of the random uncertainty are correctly identified. (2 pt.) 2 1 0

- The *source* of an uncertainty is the reason that a contributor has the uncertainty that it does. For example, in an energy measurement, a contributor to the uncertainty may come from the width of a peak; the source of this width is the energy resolution of the detection system and/or lifetime broadening of the peak.

Evidence (or lack thereof) for systematic error is shown to exist (or not exist) within the data and results. If systematic error exists, the discussion presents believable candidates for its cause. (2 pt.) 2 1 0

- Evidence for systematic error exists whenever a measurement disagrees with expectations (e.g.., $\Delta > 3\sigma$ from the literature value). Other evidence might be a skewed overall trend in the data. The reasons may be due a problem with the measurement procedure, apparatus, method of data analysis, or a theoretical model that is insufficiently complete. If no evidence for systematic error exists, this should also be demonstrated.
- Identify (and support with physical reasoning) likely causes of systematic error. Assess them quantitatively with respect to the data.