Data you have collected

You have taken data with a battery and each of 3 resistors to give 3 different currents. In the first week, you determined the current for each resistor by measuring the voltage drop across a precision resistor (ideally a purely ohmic, stable, resistance that doesn’t change with time or with temperature and is same at all currents, no inductance or capacitance). You have measured the resistance of the precision resistor, and the voltage drop across the precision resistor with a voltmeter which has internal resistance >>R_P, so voltmeter doesn’t divide the current.

The computer reads in the voltage across the sample and the current in the magnet. A constant in the program converts the magnet current to magnetic field. The program gives a value for the Hall resistance by dividing the Hall voltage by the value of Hall current that you have entered (be sure to use enough significant figures). The currents measured in the first week using the precision resistor need later correction for the difference between the Hall resistance at a given plateau and the value of the precision resistor.

Correcting the Current

The precision resistor is roughly 12.4 KΩ. The highest load resistance for the power supply is roughly 68 MΩ, the lowest is ~.75 MΩ. For i=2, no correction is necessary for difference between precision resistor and Hall resistance. For other plateaus, we need a small correction, e.g. for i=12, R_H~2Kohms, so current is increased by roughly 10/68000=.014% for the lowest current, 10/75=1.3% for the highest.

Tabulate R_H for each plateau and for each current. Higher current→ better signal to noise (but in practice signal to noise is not a problem); Higher current→ heating of sample. For the highest current sometimes see funny shape of plateaus due to heating effect.

Finding the Hall Resistance

Magneto-resistance minima are used to determine start of Hall plateaus- resistance is measured at that magnetic field. This is especially necessary for low fields, where plateaus are ill defined. When minima are broad or have not been measured, used average resistance over the plateau. Think about how to define the region of the plateau to average over.
How accurate is $R_H$?

Entering into the calculation of the Hall voltage are:
1. A measurement of the precision resistor and a measurement of the voltage drop across the precision resistor to determine the Hall current.
2. A correction to the current value.
3. A measurement of the Hall voltage.

How well have you measured the Hall current? The Hall voltage? The precision resistor? Propagate these errors to estimate the error on the Hall resistance. The precision is of course limited by the number of digits that the voltmeters display.

It would be good to check the voltmeter against a standard cell.

**Fine Structure Constant**

Calculate the value of the fine structure constant $\alpha$ from your value of the Hall resistance (see [http://physics.nist.gov/cuu/Constants/alpha.html](http://physics.nist.gov/cuu/Constants/alpha.html) details are in the 7th paragraph) Propagate errors from $R_H$ into $\alpha$.

**Why are only even levels seen?**

Explain why only even Landau levels are observed.