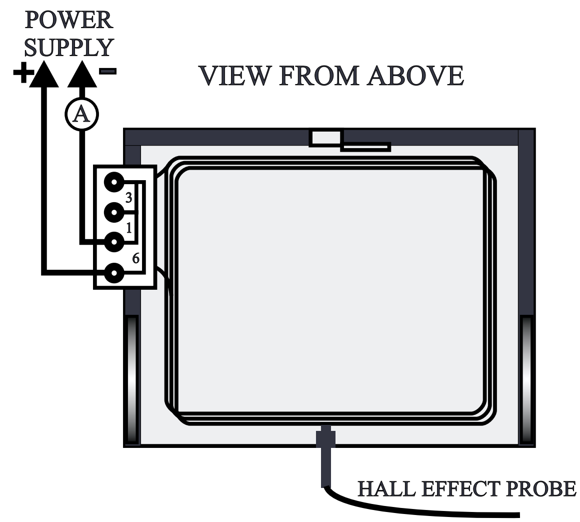
Goal - The goals of this lab are:

a. To determine the relationship between the magnetic field near a current carrying wire and the distance from that wire. [i.e. to verify the Biot-Savart Law and/or Ampere's Law]

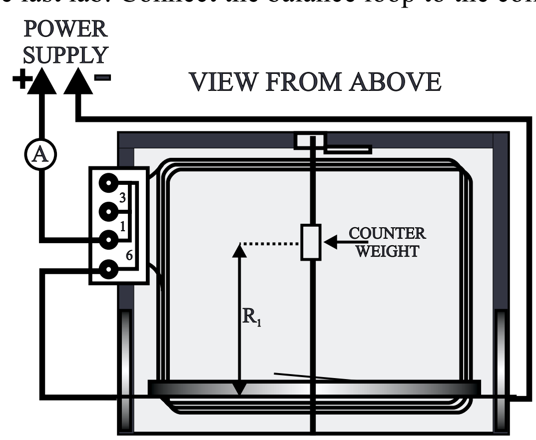
b. To measure both the magnitude and direction of the magnetic force between two current carrying wires.

Procedure -

1. First connect up an ammeter and 10 of the multiple loops within the current balance kit to the voltage supply built into the desk.
2. Adjust the current to approximately 5 - 10 Amperes and then temporarily disconnect one of the leads. Record.
3. Make sure that the Hall Effect device is properly calibrated as done in lab procedure #26.
4. Reconnect the power supply to the current loops.
5. Place the Hall Effect Probe exactly 1.0 cm from the center of the wire bundle, with the probe lying flat on the base of the current balance kit.
6. Turn the current to the loops off, adjust the DC Offset of the amplifier until the reading on the Voltmeter is as close to 0.0 Volts as possible [to compensate for the effect of the Earth's magnetic field!].
7. Take the voltage reading, turn the current on, again take the voltage reading - use the difference between these two readings to determine the magnetic field strength.
8. Using the Hall Effect Device measure the strength of the magnetic field every centimeter from the current loops as shown in the diagram until the readings are too low to measure. [about 5.0 cm.]



9. Make a graph plotting the magnetic field strength as a function of distance from the wires. From the shape of the graph determine the relationship between magnetic field strength B and distance from the wire r.
10. Select one of your data points and calculate the magnetic field strength near the current carrying wires and then compare to the theoretical magnetic field strength near the wire as determined by Ampere's Law [or the Biot - Savart Law] Don't forget that you are using ten loops of wire!
11. Next, add the balance bar with the current carrying loop and balance as in the last lab. Connect the balance loop to the coils in the bottom of the box in a simple series circuit as shown to the right
12. Adjust the distance between the ten loops in the bottom of the box and the balance loop to approximately 1.0 centimeter. Turn on the electric current and adjust to approximately 10.0 Amperes and record. This should result in the balance loop being forced away from the loop in the bottom of the box and in doing so lifting the counterbalance as in the last lab. [If the loop is pulled forward, reverse the current in either the suspended loop or the loops in the bottom of the box.] Add a counterweight of **100 milligrams** to the balance loop and adjust its position until the loop is returned to the equilibrium position. [Alternatively you can place the 100 mg mass about 15 cm from the center of rotation and then adjust the current in the circuit until you reach equilibrium!]
13. Measure and record; the mass and position of the counterweight relative to the center of rotation, the distance of the current loop from the center of rotation, the current flowing in each loop.



14. Calculate the magnetic force acting $\mathbf{F_{m1}}$ between the two wires by using the concept of rotational equilibrium.
15. Calculate the magnetic force $\mathbf{F_{m2}}$ acting between the two current carrying wires based on the equation determined in class and then compare to the force determined above.
16. Demonstrate the validity of the **right hand rule** using appropriate diagrams illustrating the directions of the currents, magnetic fields and magnetic forces acting between these two wires.