UNIVERSITY OF ALABAMA
Department of Physics and Astronomy

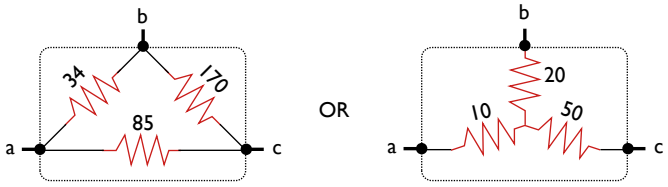
PH 102 / LeClair Summer II 2009

Problem Set 5: Mostly Magnetism

Instructions:

1. Answer all questions below. Show your work for full credit.
2. Due before the end of the day, 21 July 2009
3. Email: leclair.homework@gmail.com; hard copies: Gallalee 110 or Bevill 228.
4. You may collaborate, but everyone must turn in their own work

1. A black box with three terminals, a, b, and c, contains nothing but three resistors and connecting wire. Measuring the resistance between pairs of terminals, you measure $R_{ab} = 30\,\Omega$, $R_{ac} = 60\,\Omega$, and $R_{bc} = 70\,\Omega$. Show that the box could be either of those below.



2. In a motorboat, the compass is mounted at a distance of 0.80 m from a cable carrying a current of 20 A from an electric generator to a battery. **(a)** What magnetic field does this current produce at the location of the compass? Assume the cable is a long, straight wire. **(b)** The horizontal (north) component of the Earth's magnetic field is 1.8×10^{-5} T. Since the compass points in the direction of the *net* horizontal magnetic field, the current will cause a deviation of the compass needle. Assume that the magnetic field of the current is horizontal and at a right angle to the horizontal component of the earth's magnetic field. Under these circumstances, by how many degrees will the compass deviate from true north?

3. Suppose you move along a current-carrying wire at the same speed $v_d \ll c$ as the drift speed of electrons in the wire. Do you now measure a magnetic field of zero?

4. A wire having a mass per unit length of 0.50 g/cm carries a 2.0 A current horizontally to the right. What are the direction and magnitude of the minimum magnetic field needed to lift this wire vertically upward?