Physics 102– Pledged Problem 8

Time allowed: **2 hours at a single sitting**
Due 5PM Monday, March 19, 2007, in the boxes marked Phys 101-102 in the physics lounge. You may use your own textbook, your notes, and a non-programmed calculator. You may also consult the on-line solutions to the corresponding suggested problems. You should consult no other help. Show how you arrived at your answer; the correct answer by itself may not be sufficient.
Further instructions:
(a) Write legibly on **one** side of 8.5" x 11" white or lightly tinted paper.
(b) Staple all sheets together, including this one, in the upper left corner. Make one vertical fold.
(c) On the outside, print your name in capital letters, your LAST NAME followed by your FIRST NAME.
(d) Below your name, print the phrase "Pledged Problem 8", followed by the due date.
(e) Write and sign the pledge, with the understanding that you may consult the materials noted above.
(f) Indicate your **start time** and **end time**.

I. Two circular coils that are separated by a distance equal to their radii and that carry equal curents such that their axial magnetic fields add are called Helmholtz coils. A useful feature of Helmholtz coils is that the resulting magnetic field between the coils is very uniform. Let R=30cm, I=10A, and N=500 turns for each coil. Place one coil in the yz plane with its center at the origin and the other in a parallel plane at x=30cm.

(a) Calculate the resultant field B_x at x=10cm, x=20cm, x=30cm, and x=50cm.
(b) Use your results and the fact that B_x is symmetric about the midpoint to sketch B_x vs. x from x=0 to x=50cm.

II. The figure below shows the cross section of a long conductor of a type called a coaxial cable. The radius of the inner solid cylinder is a, and the outer cylindrical shell has inner radius b and outer radius c, as shown in the figure below. The conductors carry equal but opposite currents, with the current in the inner conductor flowing out of the page. The currents are uniformly distributed over the cross-sectional area in each case. The coordinate r measures the distance from the axis of the cylinders. Determine the magnetic field $\vec{B}(r)$ in the ranges indicated below, being sure to indicate the direction of $\vec{B}$ as well as the magnitude.
(a) $r < a$
(b) $a < r < b$
(c) $b < r < c$
(d) $r > c$.
(e) Sketch the magnitude of the magnetic field