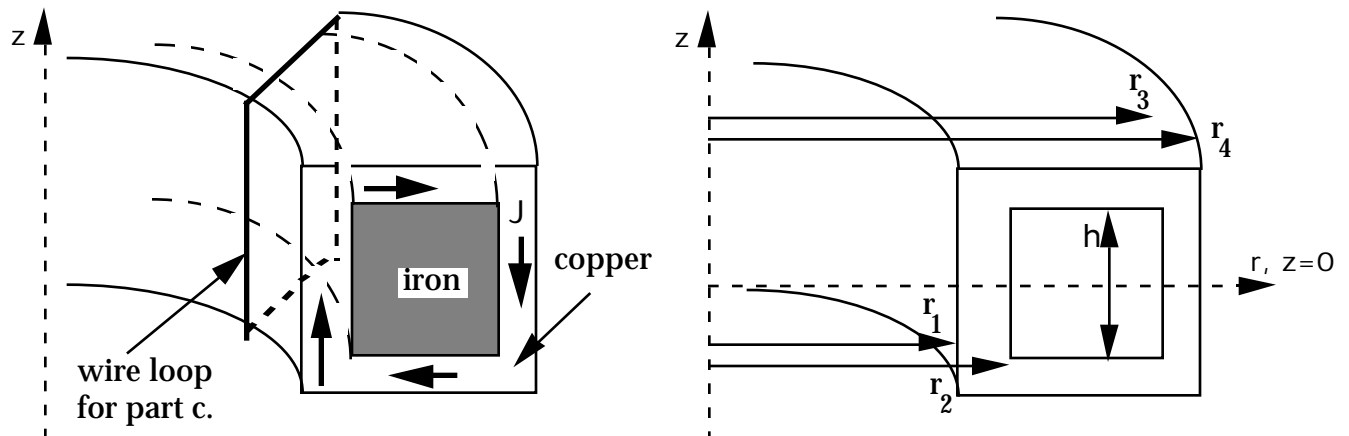


**Problem 1 - (10 points)**

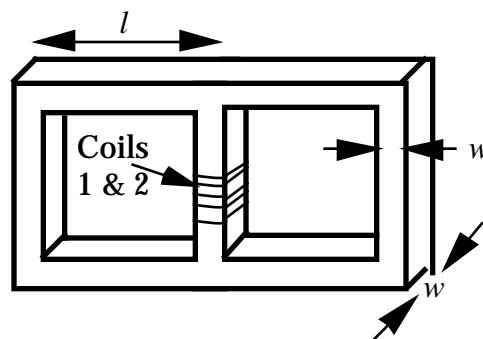
For the first problem, let's consider the toroid used in the previous homework. However, this time the core is made of soft iron.



- Along  $z = 0$ , and for  $r < r_3$ , what are  $\mathbf{H}$  and  $\mathbf{B}$ ? (Give separate expressions for each region as in the homework 4).
- Sketch  $\mathbf{H}$  and  $\mathbf{B}$  as a function of  $r$  (for  $z=0$ ). Be sure you take into account whether functions are continuous or discontinuous at the boundaries. Include a reasonable guess for  $r > r_3$ .
- Consider a wire wrapped around the outside of the conducting coil. Make reasonable approximations and calculate the flux through the loop.
- If we assume that the model for  $\mathbf{J}$  in the problem actually represents a 1 turn coil, find the inductance of the coil. (make reasonable approximations).

**Problem 2 - (10 points)**

A transformer is made as shown below. Both the primary and secondary windings are wrapped around the center post with the secondary windings wound over the top of the primary. All posts have a square cross-section ( $w \times w$ ) and length  $l$ . When in operation, the current in winding 1 is  $I_1$  and the current in winding 2 is  $I_2$ .



Determine the following parameters

- self inductance of each coil, and the mutual inductance between the two coils,
- $|\mathbf{B}|$  and  $|\mathbf{H}|$  in the center post, and  $|\mathbf{H}|$  in the outer post
- the stored energy in the system using equations (150) and (166).