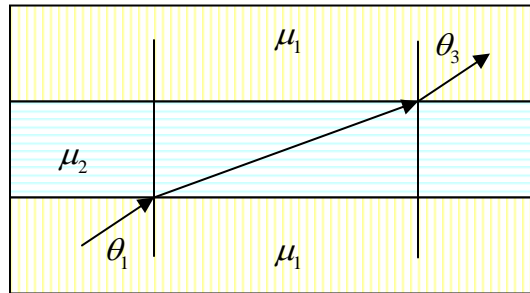


Homework 6

Due 5 April 2005

1. Boundary Conditions

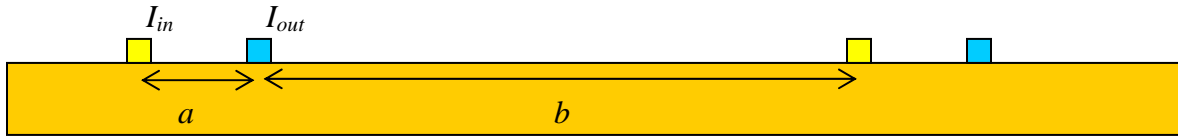


A magnetic field vector is obliquely incident on a slab of a material with a different permeability μ . From your knowledge of boundary conditions, determine the relationship between θ_1 and θ_3 where these angles are measured with respect to the normal.

Homework 6

2. Mutual Inductance

On a printed circuit board, there are two nearby wire traces carrying signals. We wish to determine the coupling between the traces. The board is made of an insulating material so it has no affect on the magnetic field produced by the currents.

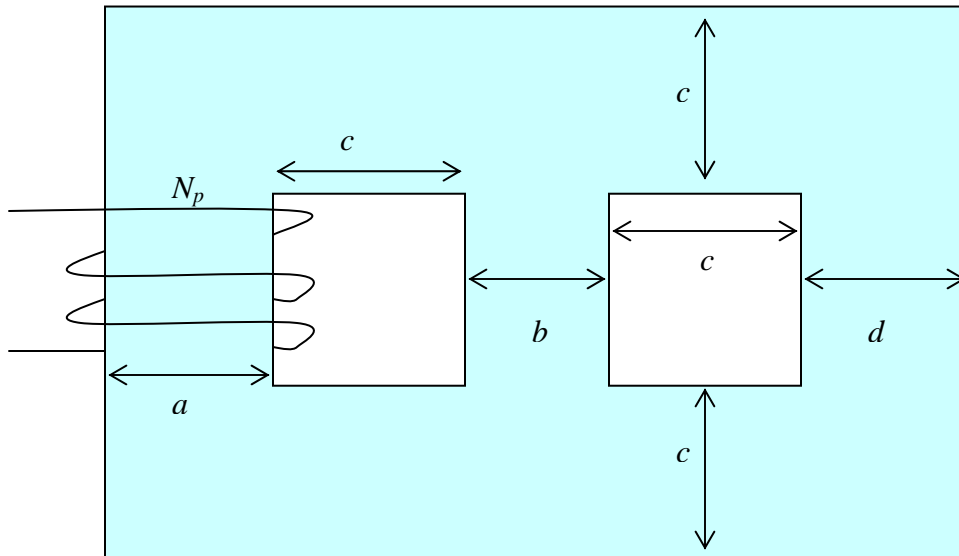


Assume that there is current flowing in the pair on the left, with the current into the page in the left-most wire and returning in the right. The wire pairs are separated by a distance a and the two sets of wires are separated from one another by a distance b .

- Determine the magnetic field produced by the currents in the left hand wire pair.
- Determine the flux linked by the second pair of wires.
- Determine the mutual inductance between the two sets of wires.

Homework 6

3. Magnetic Circuits



a. A magnetic core with the geometry shown has N_p windings wrapped around its left post. The core has a rectangular cross section with depth w . The permeability of the core is μ . Using the magnetic circuit technique, find the inductance of this configuration and the total energy stored for a current I in the coil. Note that the total width of the core is $a+b+2c+d$ and the total height is $3c$.

b. If a second winding with N_s turns is wrapped around either the center post or the right post and if $b < d < c$, for which choice will the mutual inductance be larger? Evaluate the mutual inductance for both cases. Are there specific conditions (size of a, b, c , etc.) for one to be larger than the other?

c. For completeness and simplicity, let $w = c = 2\text{cm}$, $a = 3\text{cm}$, $b = 1\text{cm}$, $d = 2\text{cm}$. What are the self and mutual inductances?