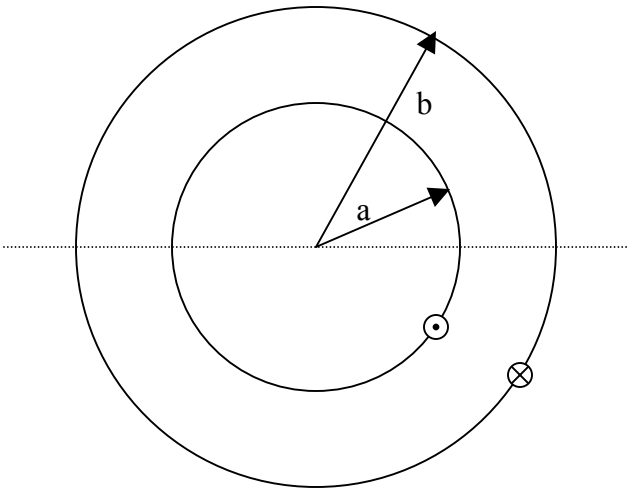
Fields and Waves I

Name _____ **ECSE-2100 Spring 2003 Section** _____

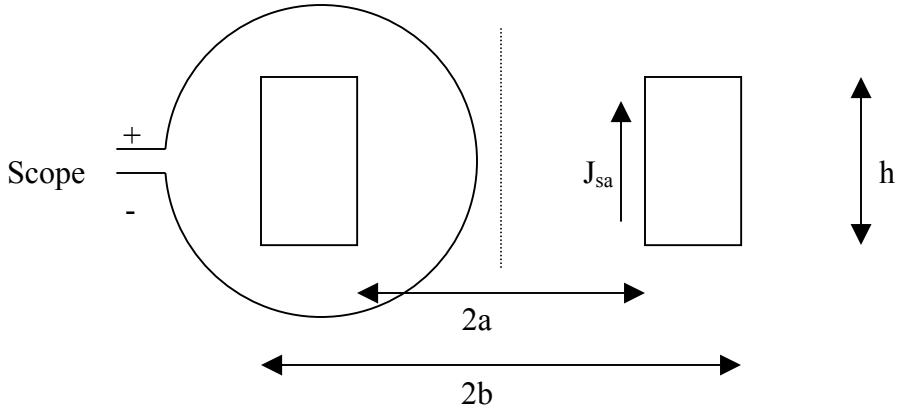
Homework 5

Due Thursday 27, March, 2003

4) Faraday's Law



Overhead View



Cross sectional view

The above two figures represent a toroid with a square cross section. In the overhead view, the dashed line represents the plane used to form the cross sectional view. In the cross sectional view, the dashed line represents the axis $r = 0$. As discussed in class, the magnetic field only exists inside the toroid ($a<r<$b and $0<z<l$). A surface current exists on the toroid (refer to the book for a figure illustrating a wire wrapped toroid). In the cross sectional view, the direction of the surface current at $t = 0$ is shown, in the $+z$ direction on the inner surface of the toroid. The time varying current on this surface is $J_{sa}\cos(\varpi t)$ [A/m].

1) In terms of the surface current on the inner surface and the geometry, determine the magnetic field, $\vec{H}$. It is not necessary to follow all the steps of the previous problems, however, it is recommended.

2) In the cross sectional view, 10 windings are wrapped around the toroid as shown by the circle on the left side. The circle has radius, r_o. Determine the time varying total flux through the windings.

3) Determine the EMF measured by the oscilloscope. Be careful when determining signs since phase is an important aspect of this type of applications (transformers, motors, etc.)

Extra Credit) Determine the surface current density everywhere on the toroid.