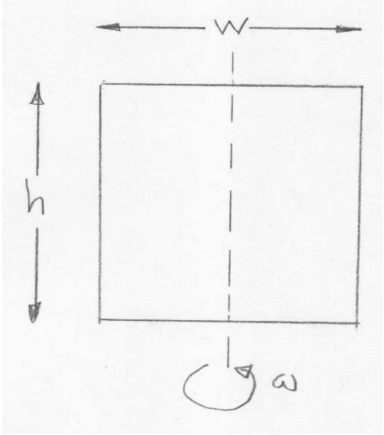
Physics 322, Winter Quarter 2016
Electrodynamics: Homework Assignment 5
(a) Turn in all problems and clearly note all constants and assumptions you use. (1-point penalty each otherwise)
(b) Use 8½ x 11 paper & staple (1-point penalty each otherwise)
(c) Due February 11 either 9:00 am in class or 8:45 am in the instructor's mailbox; late homework gets 0.

1. A certain capacitor consists of two concentric spherical conductors of radii R_I and R_O. The volume between the two conductors is a slightly conducting, non-magnetic dielectric of conductivity σ and permittivity ε_0.
a. Find the resistance *R* and capacitance *C* of this 2-conductor device.
b. Suppose this device is slowly discharging through it's own dielectric. If the current at time zero is I_0, find the discharge current *I* at later times.
c. Find the magnetic field **B** everywhere.
d. Find the inductance *L* of this device.

2. Recall a problem from last week: The rectangular loop shown rotates with angular frequency ω. Now, not only is the loop rotating, but the magnetic field is changing as $B(t) = B_0 \sin \omega t$ where this field is perpendicular to the plane of the loop at t = 0.
a. Find the magnitude of the *emf* around the loop.
b. Find the angular frequency of the *emf*.



3. a. Evaluate the line integral of $\mathbf{E} + \partial\mathbf{A}/\partial t$ around an arbitrary closed path. b. Find the expression for **E** in terms of the scalar potential *V* and the vector potential **A**, valid for non-static fields.

4. A long solenoid of n turns/length and radius *R* carries slowly-varying current $I(t) = I_0 \sin \omega t$. Further suppose a non-magnetic rod of conductivity σ completely fills the solenoid bore.
a. Find the current distribution in the rod.
b. Find the magnetic field in the bore.
c. Find the heat given off per length of rod.
d. Discuss the behavior of your answers for limiting cases where the conductivity is very large and very small.
e. Discuss how your answers would change if the rod were coaxial with the solenoid but of smaller radius.

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