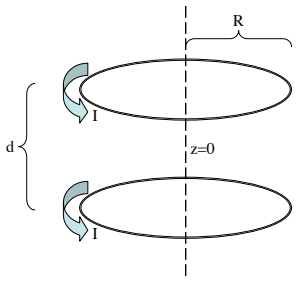
1 Helmholtz coil

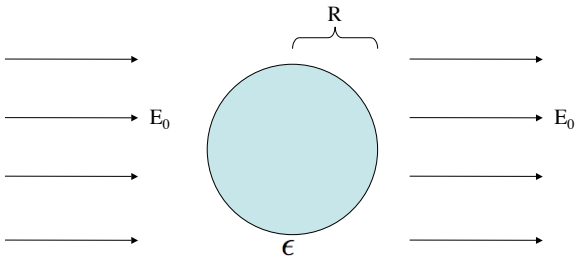
The Helmholtz coil in Fig. (1) produces a fairly uniform magnetic field at $z = 0$ for the optimal setting of d. Find $B(z)$, the magnetic field on the z-axis, in terms of the separation d and coil radii R. Show that the first derivative of $B(z)$ vanishes at $z = 0$ for any d and find the value of d for which the second derivative of $B(z)$ vanishes at $z = 0$ as well.



2 Dielectric dipole radiation

A sphere of homogeneous linear dielectric material with permittivity ϵ is placed in an otherwise uniform electric field E_0, as shown in Fig. (2). Find the electric field everywhere.

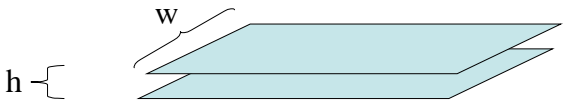
Now the external field is made to slowly oscillate at frequency ω, so that it's amplitude is given by $E(t) = E_0 \cos \omega t$. Find the dipole moment of the sphere $p(t)$ and the power radiated in the dipole approximation P_{rad}.



3 Transmission Line

The transmission line in figure Fig. (3) is constructed from two thin metal ribbons, of with w, a very small distance $h \ll w$ apart. Current travels down one strip and back along the other, uniformly over the surface.

Find the capacitance and inductance per unit length, and their product.



(all problems more or less pirated from Griffiths' E&M text)

4 Field from a moving point charge

A point charge q is at rest at the origin in system S_0. What is the electric field of this same charge in system S, wchich moves to the right at speed v_0 relative to S_0.