FUNDAMENTALS OF ELECTROMAGNETIC FIELDS – Jun 28, 2017

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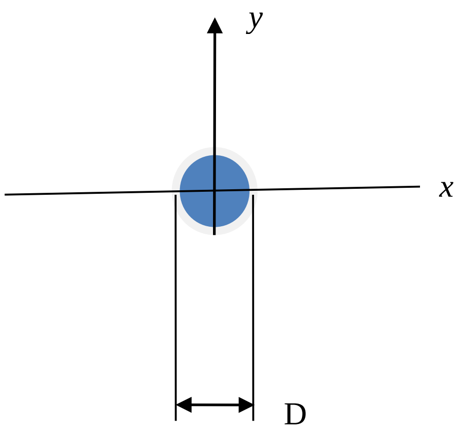
Problem 1 **-** Consider two uniformly charged spheres, both of radius R=1 cm and placed at 3 cm from each other (distance between the centers)**.** The total charge on each sphere is 10^{-3} C, but the sign of the charge is opposite on the two spheres. Find

- The electrostatic potential at half the radius (0.5 cm from the center) for each sphere;
- The electric field at half the radius (0.5 cm from the center) for each sphere;
- The electric field half way between the spheres.

<u>Problem 2</u> **-** Consider the indefinite cylinder whose section is shown in the figure (diameter D = 2 cm). On the wire flows a current density (directed **inside** the paper) distributed as follows:
$J(r) = 1+(r/D)^2$ (A/m^2), where r is the distance from the origin. Find

- the magnetic field at 4 cm from the wire center
- the magnetic field inside the wire at 0.5 cm from the center.

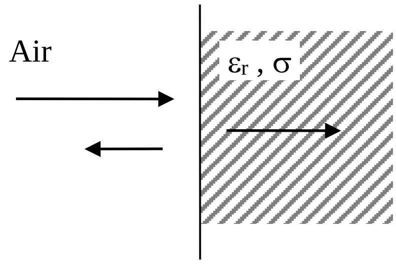


Problem 3 **-** A plane wave at 5 GHz and having an electric field of 100 mV/m is normally incident on a medium with $\varepsilon_r = 5$, $\sigma = 0.01$ S/m. Find

a) the total magnetic field at the interface (in magnitude);

b) the power density at 10 cm from the interface in medium 2;

d) the distance from the interface at which the power density is reduced by a factor of 10.



Problem 4 - A source with 10 W available power and 100 Ω internal impedance is connected to a 150 Ω load by a 100 Ω characteristic impedance transmission line. The line length is 15 m, the frequency is 3 GHz and the line is a parallel plate line with the following parameters:
width $w = 0.5$ cm, height h (to be found), $\varepsilon_r = 1$, conductivity of metals $\sigma = 5 \cdot 10^7$ S/m.
Find

a) The power absorbed by the load;
b) The power lost on the line.