FUNDAMENTALS OF ELECTROMAGNETIC FIELDS – Sept 20, 2016

Name:
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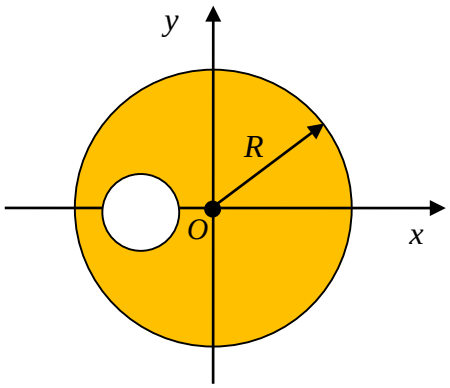
Problem 1 - Consider the geometry in the figure, consisting of a uniformly charged **sphere** of radius R = 15 cm with a spherical hole at 6 cm from the center and with a radius of 4 cm. The charge density is uniform and equal to 10^{-10} C/m^3. Calculate

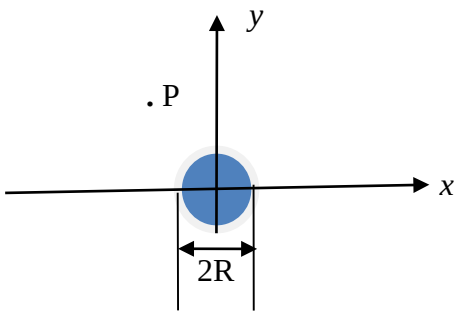
a) the magnitude of the electric field at the point P(x=4cm, y=3cm, z=0 cm).

b) the potential at the same point.



Problem 2 - Consider the wire in the figure, whose conductivity is $\sigma = 20$ S/m. It is placed at the origin, its radius R is 2cm and it carries a constant current of 3 A uniformly distributed and directed along z. Find

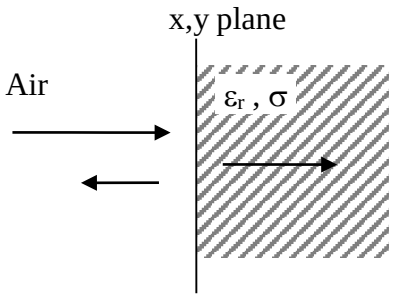
- the magnitude and the direction (angle with respect to x-axis) of the magnetic field at P(x=–2cm, y=3 cm, z=3cm)
- the power dissipated on a length of 2 m.



Problem 3 - A plane wave is incident onto the half-space shown in the figure. The parameters of the half-space are $\varepsilon_r = 4$, $\tan\delta = 0.2$. The **transmitted** power density is 25 mW/m^2 at 2.4 GHz and at 2 cm from the interface. Find

a) the magnitude of the **incident** electric field (medium 1);

b) the magnitude of the **trasmitted** power density at 4 cm from the interface.



Problem 4 - A source with an open circuit voltage V_0 = 20 V and R_g = 75 Ω internal impedance is connected to a load R_L = 50 Ω by a coaxial line having outer diameter *a*=5 mm, characteristic impedance 50 Ω and dielectric constant ε_r = 4.2, tanδ = 0.02. The line length is *l*=15 m, the frequency is 1.5 GHz and the conductors are made with copper ($\sigma = 5 \cdot 10^7$ S/m). Find

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