Introduction to Electricity and Magnetism B38EM

Tutorial #4

$\varepsilon_0 = 8.85\text{x}10^{-12}\ \text{Fm}^{-1}$, $e = 1.6\text{x}10^{-19}\ \text{C}$, $1\ \text{nC} = 10^{-9}\ \text{C}$

1- Uniform surface charge densities of *6, 4,* and *2* nC/m^2 are present at *r = 2, 4,* and *6* cm respectively. Assume potential *V=0* at infinity. Find *V(r).*

2- Calculate the divergence of the following vector functions:

(a) $\mathbf{V_a} = x^2\,\mathbf{i} + 3xz^2\,\mathbf{j} - 2xz\,\mathbf{k}$

(b) $\mathbf{V_b} = xy\,\mathbf{i} + 2yz\,\mathbf{j} + 3zx\,\mathbf{k}$

(c) $\mathbf{V_c} = y^2\,\mathbf{i} + (2xy+z^2)\mathbf{j} + 2yz\,\mathbf{k}$

3- By employing the appropriate line integral for the electric field, demonstrate that, at an interface between two dielectric regions the tangential electric field is continuous.

(Note: The normal components of the electric flux density are continuous across the interface).

4- Consider a straight non-magnetic conductor of circular cross-section and radius *a* carrying a current *I* in the vertical direction. Using Ampere's law find the magnetic field inside and outside the conductor.

5- Using the same methodology as above, find the magnetic field everywhere in the cross-section of a coaxial cable. The radius of the inner conductor is *a*, the radius of the inner surface of the outer conductor is *b*, the radius of the outer surface of the outer conductor is *c*. The coaxial cable as a current in the inner conductor of I and a current in the outside conductor of *–I*.

6- Find the magnetic field due to an infinite sheet of current flowing in the *y*-direction.