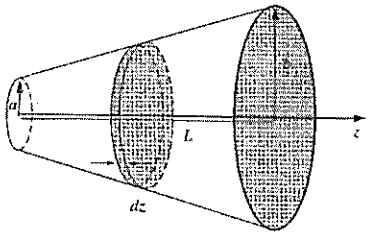
2019 Spring PHYS2320 電磁學 (Electromagnetism) Midterm Makeup Exam

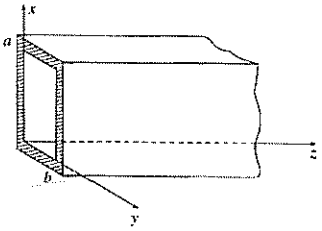
[Griffiths Chs. 7.2-9] 2019/05/28, 11:00am – 12:00am, 教師：張存續 滿分 50

1. (a) Calculate the resistance of a conical shaped object, of resistivity ρ, with length L, radius a at one end and radius b at the other. The two ends are flat, and are taken to be equipotentials. The suggest method is to slice it into circular disks of width dz, find the resistance of each disk, and integrate to get the total. Calculate R this way. (8%)

   (b) Suppose the ends are, instead, spherical surfaces, centered at the apex of the cone. Calculate the resistance in this case. (Let L be the distance between the centers of the circular perimeters of the caps.) (7%)



2. A wave is propagating in a rectangular waveguide with fundamental TE_{10} mode.
   $B_z(x,z,t) = B_0 \cos(\pi x / a)\cos(kz - \omega t)$.



(a) Find E_x, E_y, B_x, and B_y? (8%) [Hint: Express in real components.]

(b) Find the Poynting vector **S**? (6%) [Hint: **S** is a vector.]

(c) Find the time averaged power P_{TE} in the z-direction. (6%)
[Hint: $P_{TE} = \left\langle \int_A \mathbf{e}_z \cdot \mathbf{S}_{TE}\, da \right\rangle$ (A: crossectional area)].

3. A plane wave of frequency ω, traveling in the z direction with the electric field polarized in the x direction, is incident from vacuum (ε_0 and μ_0) to a dielectric with $\varepsilon = 9\varepsilon_0$ and $\mu = \mu_0$. The incident wave is

   $\tilde{\mathbf{E}}_I(z,t) = \tilde{E}_{0I} e^{i(kz-\omega t)}\hat{\mathbf{x}}$ and $\tilde{\mathbf{B}}_I(z,t) = \frac{1}{c}\tilde{E}_{0I} e^{i(kz-\omega t)}\hat{\mathbf{y}}$, where k is the corresponding wave number.

(a) Write down the reflected wave ($\tilde{\mathbf{E}}_R(z,t)$, $\tilde{\mathbf{B}}_R(z,t)$) and the transmitted wave ($\tilde{\mathbf{E}}_T(z,t)$, $\tilde{\mathbf{B}}_T(z,t)$). (8%)

(b) Express the reflected amplitude $\tilde{E}_{0R}$ and transmitted amplitude $\tilde{E}_{0T}$ in terms of the incident amplitude ($\tilde{E}_{0I}$). (7%)