1. (A) (15 pts) As shown in figure (a) below, an uniform charge distribution of density ρ (>0) in the infinitely long cylindrical region where $|r| \leq R$, and $r = (x^2+y^2)^{1/2}$. Find the E-field (direction and magnitude) on x-axis for $0 \leq x \leq 2R$.

(B) (10 pts) Now an layer of negative charges with the same density is placed around the charges in part (a), as shown in figure (b). Find the E-field (direction and magnitude) again on x-axis for $0 \leq x \leq 2R$.

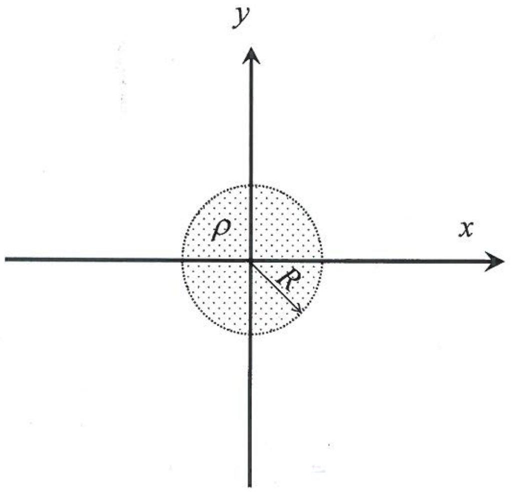

Figure (a)

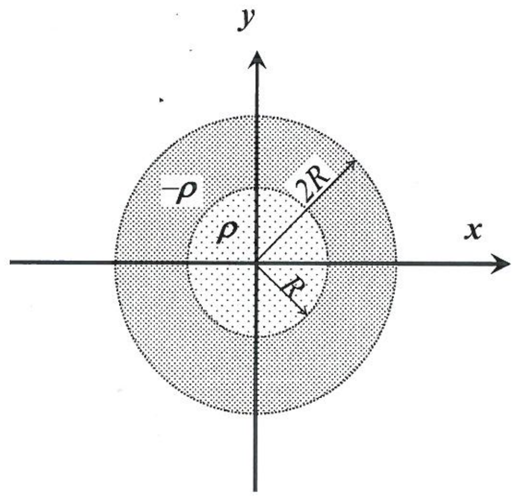

Figure (b)

2. (A) (15 pts) As shown in the figure (a) below, in the region where $|x| \leq d$, there is an uniform current distribution of density J (>0) in the z-direction (out of page). Find the B-field (direction and magnitude) on x-axis for $0 \leq x \leq 2d$.

(B) (10 pts) Now half of the current is replaced with current in the opposite direction (**into** the page) with the same density, as shown in figure (b). Find the B-field (direction and magnitude) again on x-axis for $0 \leq x \leq 2d$.

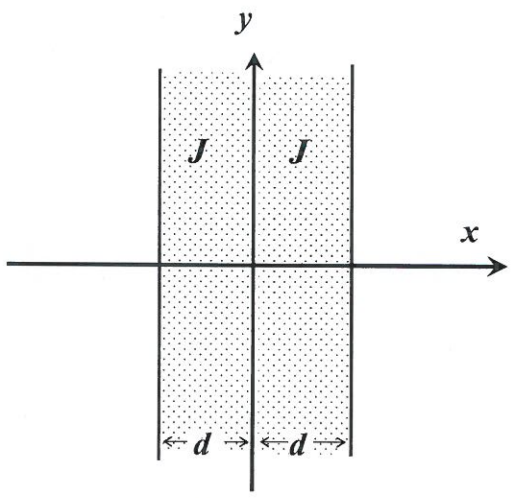

Figure (a)

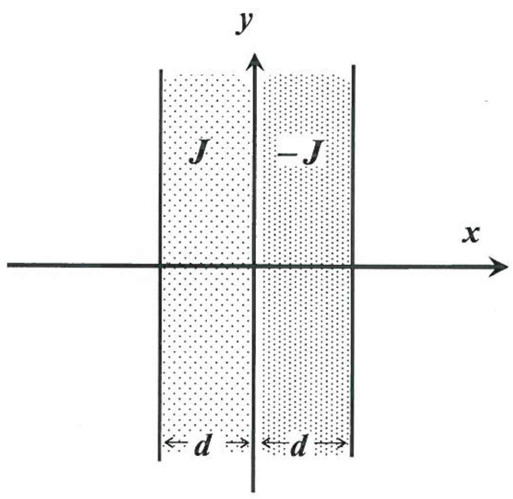

Figure (b)

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3. The circuit in Figure A is situated in a magnetic field $\vec{B} = \vec{a_z} 5\cos(7\pi 10^9 t - \frac{4}{5}\pi x)$

Assuming R=15Ω, find the current i. Here we use the unit as μT. (10%)

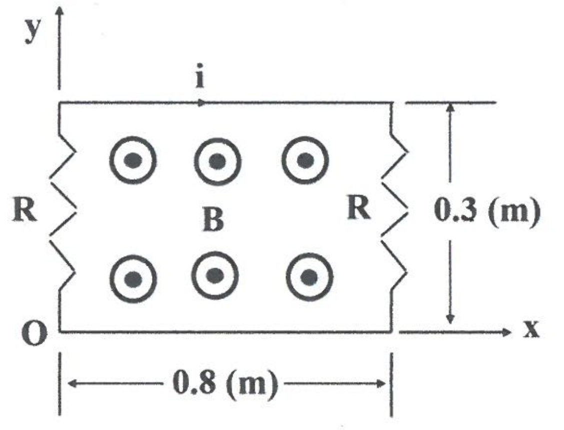

Figure A

4. Determine the phase retardation between the TE and TM waves that is introduced by total internal reflection at the boundary between glass (n=1.5) and air (n=1) at an angle of incidence $\theta = 1.2\theta_c$, where θ_c is the critical angle. (10%)

5. The electric-field complex-amplitude vector for a monochromatic wave of wavelength λ_o traveling in free space is $\vec{E}(\vec{r}) = E_O \sin\beta y\, e^{-j\beta_z}\vec{x}$

(a) Determine a relation between λ_o and β (5%).

(b) Derive an expression for the magnetic-field complex-amplitude vector $\vec{H}(\vec{r})$ (10%)

(c) Determine the direction of the flow of optical power (5%).

(d) This wave may be regards as the sum of two TEM plane waves. Determine their direction of propagation (10%).

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