

國立中央大學98學年度碩士班考試入學試題卷

所別：太空科學研究所碩士班 一般生 科目：電磁學 共 2 頁 第 1 頁

學位：在職生

*請在試卷答案卷(卡)內作答

1. A sphere of radius a , contains a constant electric charge density ρ_0 (C/m^3) in it.

(a) Find the electric field \vec{E} at a point P_1 inside ($0 < R_1 < a$) and at a point P_2 outside ($R_2 > a$) the sphere. (5%)

(b) Find $\nabla \cdot \vec{E}$ at these two points. (10%)

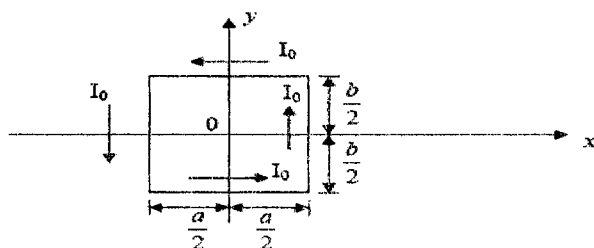
2. A long cylindrical wire of radius a , carries a current I_0 (amp) in it.

(a) Find the magnetic field intensity \vec{H} at a point P_1 distance r_1 ($0 < r_1 < a$) from the axis and at a point P_2 distance r_2 ($r_2 > a$) from the axis. (5%)

(b) Find $\nabla \times \vec{H}$ at these two points. (10%)

3. As shown in the figure, a long wire is bent into a rectangular shape, side length a and b (meters), and lies in the xy plane of a Cartesian coordinate system. A current I_0 (amp) passes through the wire. Find the force and the torque on the rectangular wire when a magnetic field $\vec{B} = \vec{a}_x B_x + \vec{a}_y B_y + \vec{a}_z B_z$ (tesla)

appears. (10%)



4. Use Maxwell's equations to derive the wave equations for scalar potential V and vector potential \vec{A} . (10%)

5. Use Maxwell's equations to derive the Poynting's theorem and explain the physical meaning of each term in the equation of the theorem. (10%)

6. Derive Snell's law of reflection and Snell's law of refraction for a plane wave obliquely incident on a plane boundary between two lossless media (ϵ_1, μ_1 and ϵ_2, μ_2). (10%)

參考用

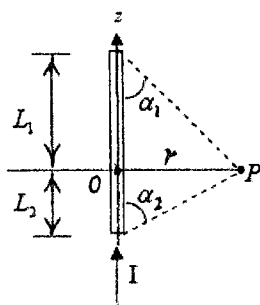
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7. The Faraday disk generator consists of a circular metal disk (radius b) rotating with a constant angular velocity ω in a uniform magnetic field of flux intensity $\vec{B} = \vec{a}_z B_0$ that is parallel to the axis of rotation. Find the open-circuit voltage between the rim of the disk and the axis of the disk. (5%)
8. A spherical dielectric body (radius b , and permittivity ϵ) carries a constant polarization vector, $\vec{P} = \vec{a}_z P_0$ (C/m²), is placed at the origin of a Cartesian coordinate system.
- (a) Find the bound-charge distribution on the surface of the sphere. (5%)
- (b) Find the electric field intensity \vec{E} at a point that is R distance away from the origin ($R \gg b$). (10%)
9. As shown in the figure, a short wire of length L ($L = L_1 + L_2$) that carries a current I , is placed along the z -axis of a cylindrical coordinate system.



Show that the magnetic field of flux intensity \vec{B} at point P (distance r from axis) in the figure is given by $\vec{B} = \vec{a}_\phi \frac{\mu_0 I}{4\pi r} (\cos \alpha_1 + \cos \alpha_2)$ (T). (10%)

參考用