

本試題是否可以使用計算機： 可使用， 不可使用（請命題老師勾選）

- Given a field function $\mathbf{E} = \mathbf{a}_x(y - c_1z) + \mathbf{a}_y(c_2x - 2z) + \mathbf{a}_z(c_3y + z)$.
 - Determine the constants c_1 , c_2 , and c_3 if \mathbf{E} is irrotational.
 - Determine its scalar potential function V with the condition $V(1, 1, 1) = 5$. (20%)
- Determine the electric field caused by a spherical distribution of anions in a homogeneous solution with a volume charge density $\rho = \rho_0$ for $0 \leq R \leq a$ (both ρ_0 and a are positive) and $\rho = 0$ for $R > a$. (20%)
- A simplified model for the electric activity of heart may be considered as an electric dipole varying with time. For a time instant, the equivalent dipole may be approximated as \mathbf{p} in y - z plane as shown in Fig 1. Determine the potential and electric field at point A. Note: Denote and describe clearly your variables for the material properties in the space. (20%)

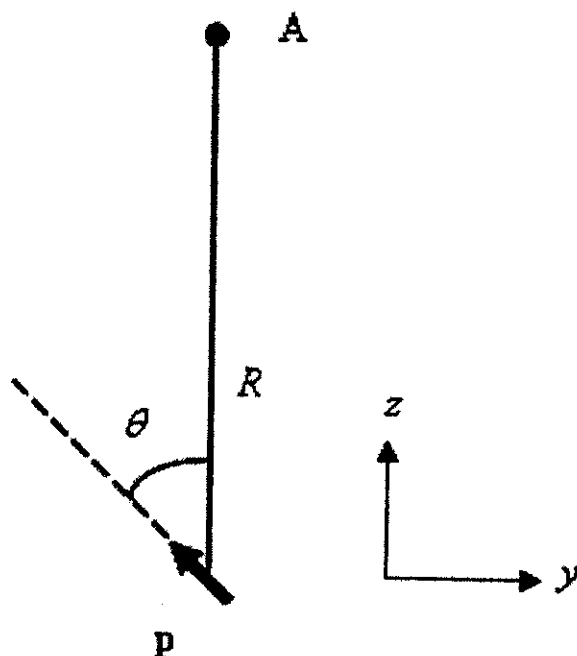


Fig. 1

(背面仍有題目,請繼續作答)

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4. A new technique called transcranial magnetic stimulation has been developed for psychiatric treatment. It is a technique to apply the magnetic field to stimulate the cortex. A current-carrying circular loop with the radius a and current I (as shown in Fig. 2) may be used as a simple magnetic stimulator for this purpose. Determine the magnetic flux density at point A. Note: Denote and describe clearly your variables for the material properties in the space. (20%)

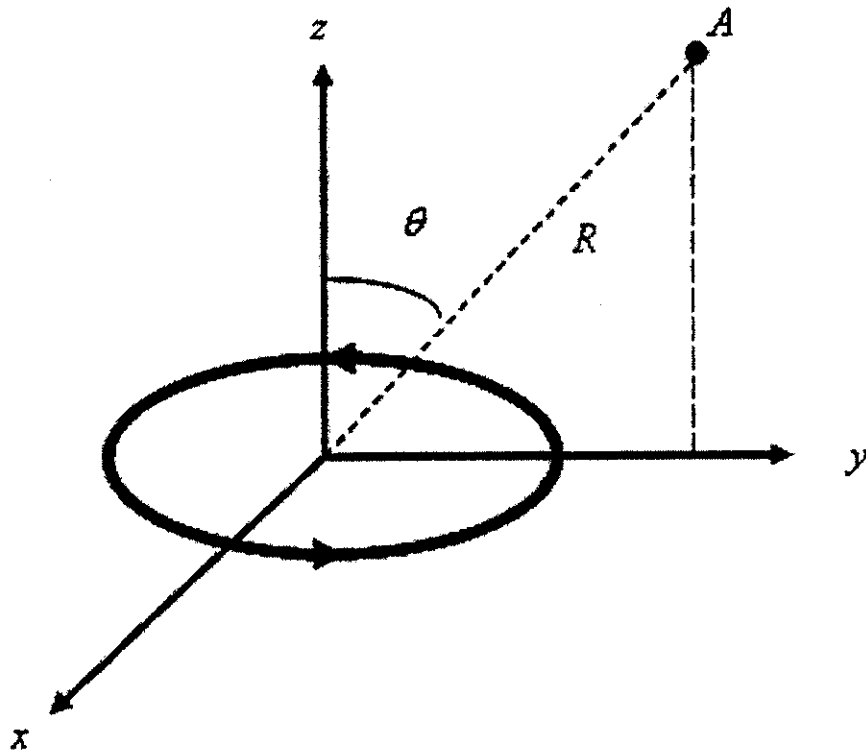


Fig. 2

5. A dielectric layer of thickness d and intrinsic impedance η_2 is placed between media 1 and 3 having intrinsic impedances η_1 and η_3 , respectively. Determine d and η_2 such that no reflection occurs when a uniform plane wave in medium 1 impinges normally on the interface with medium 2. (10%)
6. Find the Poynting vector on the surface of a long, straight conducting wire of radius b and conductivity σ that carries a direct current I . (10%)