科目 電磁學 類組別 031

＊請在試卷、答案卡內作答

參考用

1. Two point charges +Q and –Q are situated on a diameter of a grounded conducting sphere of radius *a* at distances D > *a* to the right and to the left, respectively.
   (a) (10%) Find the dipole moment constituted by image charges.
   (b) (10%) Let D and Q approach infinity in such a way that Q/D^2 remains constant. Superpose the field of ±Q and of the dipole to find the field outside the sphere.
   (c) (10%) Assume that the field due to the charges ±Q is E_0, find the surface charge density of the sphere.

2. (10%) What current density would produce the vector potential, $\vec{A} = k\hat{\phi}$ (k is a constant) in cylindrical coordinates?

3. (10%) A thin uniform donut, carrying charge Q and mass M, rotates about its axis. Find the ratio of its magnetic dipole moment to its angular momentum.

4. The **E**-field of a uniform plane wave propagating in a dielectric medium is given by

$$\mathbf{E}(z,t) = \mathbf{a}_x 2\cos(10^8 t - \frac{z}{\sqrt{3}}) - \mathbf{a}_y 2\cos(10^8 t - \frac{z}{\sqrt{3}}) \quad (\mathrm{V/m})$$

   (a) (3%) What is a uniform plane wave?
   (b) (7%) What is the dielectric constant of the medium?
   (c) (5%) Describe the polarization of the wave and explain your answer.
   (d) (5%) Find the corresponding **H**-field.

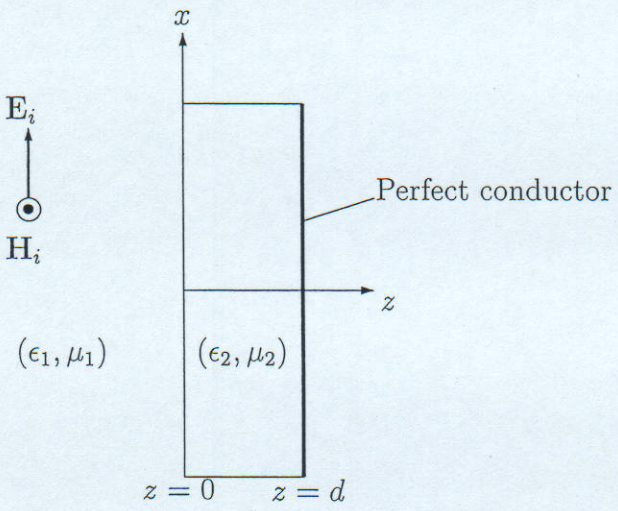
注意:背面有試題

參考用

5. A time-harmonic uniform plane wave with

$$\mathbf{E}(z) = \mathbf{a}_x E_{i0} e^{-j\beta_1 z}$$

in medium 1 (ϵ_1, μ_1) is incident normally onto a lossless, perfect-conductor-backed dielectric slab (ϵ_2, μ_2) of a thickness d.



(a) (2%) Please draw the direction of the incident wave vector $\mathbf{k}_i$.

(b) (3%) If the amplitude of the reflected electric field in medium 1 is E_{r0}, write down the phasor expressions of the electric ($\mathbf{E}_1(z)$) and magnetic fields ($\mathbf{H}_1(z)$) in medium 1.

(c) (8%) Assume the propagation constant of the wave in medium 2 is β_2. Write down the phasor expressions of the electric ($\mathbf{E}_2(z)$) and magnetic fields ($\mathbf{H}_2(z)$) in medium 2 as a function of E_2^+ (the amplitude of the forward-propagating electric field in medium 2), β_2, d, and (ϵ_2, μ_2).

(d) (7%) Applying the boundary condition at $z = 0$ to determine the relationship between E_{i0} and E_{r0}.

(e) (5%) Find out the thickness d at which $E_{r0} = -E_{i0}$.

(f) (5%) What is the physical meaning of having $E_{r0} = -E_{i0}$?