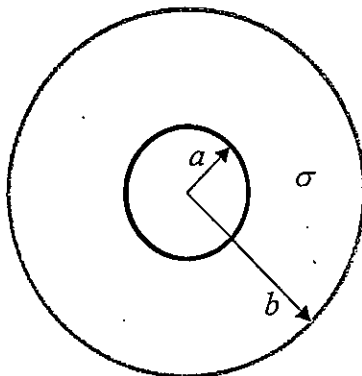


※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

- Charge is distributed with density  $\rho = \rho_0 (r/a)^2$ , where  $\rho_0$  is a constant, in the sphere  $r < a$ . Find displacement field  $\mathbf{D}$  everywhere and plot  $D_r$  versus  $r$ . (10%)
- A boundary separates free space from a perfect dielectric medium. At a point on the boundary, the electric field intensity on the free space side is  $\mathbf{E}_1 = E_0 (4\mathbf{a}_x + 2\mathbf{a}_y + 5\mathbf{a}_z)$ , whereas on the dielectric side, it is  $\mathbf{E}_2 = 3E_0 (\mathbf{a}_x + \mathbf{a}_z)$ , where  $E_0$  is a constant. Find the permittivity of the dielectric medium. (10%)
- A spherical shell has inner and outer radii  $a$  and  $b$ , respectively. Assume that the shells has a uniform conductivity  $\sigma$  and that it has copper electrodes plated on the inner and outer surfaces. Find the resistance if  $a = 0.2$  mm,  $b = 2$  cm and  $\sigma = 5$  S/m. (10%)



- A grounded metal sheet is located in the  $z = 0$  plane, while a point charge  $Q$  is located at  $(0, 0, a)$ . Find the force acting on a point charge  $-Q$  placed at  $(a, 0, a)$  if  $a = 2$  cm and  $Q = 0.1\sqrt{\pi\epsilon_0}$  C. (10%)
- Transverse electric modes are excited in an air dielectric parallel-plate waveguide of dimension  $a = 5$  cm by setting up its mouth a field distribution having

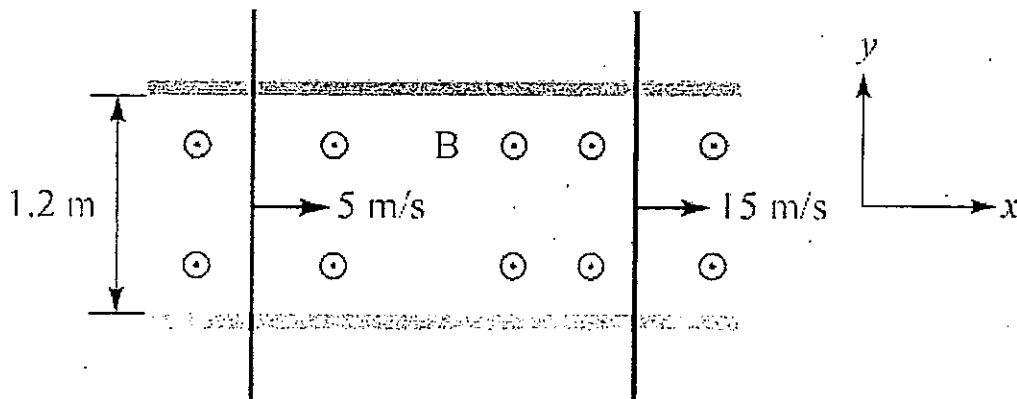
$$\mathbf{E} = 10(\sin 20\pi x + 0.5 \sin 60\pi x) \sin 10^{10} \pi t \mathbf{a}_y$$

Determine the propagating mode(s) and obtain the expression for the electric field of the propagating wave. (10%)

- A uniform plane wave in air is normally incident on an infinite lossless dielectric material occupying  $z > 0$  and having  $\epsilon = 3\epsilon_0$  and  $\mu = \mu_0$ . If the incident wave is  $\mathbf{E}_i = 10 \cos(\omega t - z) \mathbf{a}_y$  V/m, find  $\omega$  and the total electric field and the time average power in both regions. (15%)

7. Two conducting bars slide over two stationary rails, as illustrated in the figure shown below. If

$B = 0.2a_z$  Wb/m<sup>2</sup>, determine the induced emf in the loop thus formed. (10%)



8. A  $50 \Omega$  air-filled slotted line is applied in measuring a load impedance  $Z_L$ . Adjacent minima are found at 14 cm and 22.5 cm from the load when the unknown load is connected, and the measured maximum and minimum voltages are  $V_{\max} = 0.95V$  and  $V_{\min} = 0.45V$ , respectively. When the load is replaced by a short circuit, the minima is 3.2 cm shift to the load. Determine  $Z_L$ . (15%)

9. A magnetic circuit is given in the figure ( $\mu = 8\mu_0$ ). A single turn of wire carrying a current  $I$  is placed in the gap. Assume all flux is contained within the magnetic circuit and the magnetic path length is the average length of the corresponding sections. Assume  $e = 2b, a = 24b, d = 12b, c = 4b, g = 0.5b$  and calculate the flux and magnetic field in the central leg of the magnetic circuit. (10%)

