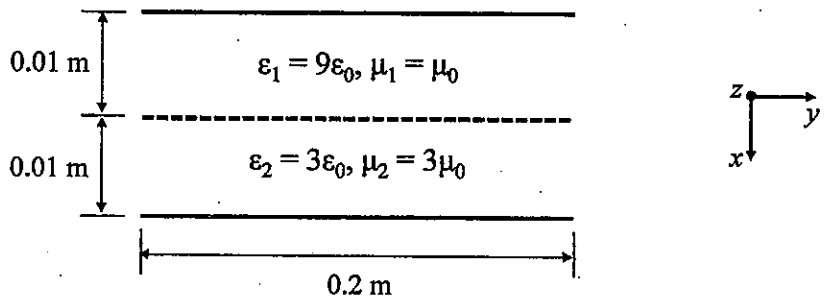
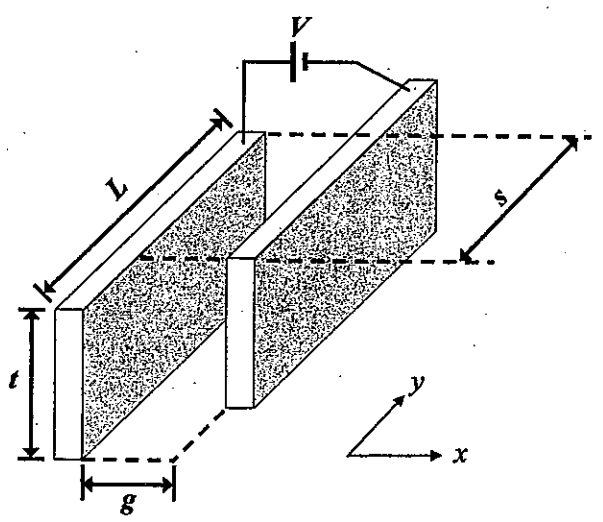
1. Consider a uniform plane wave propagating in free space. The electric field of the wave is $\mathbf{E} = E_0 \cos(10\pi\times10^{12}t - \beta\times x)\,\mathbf{a}_z$. The speed of light in free space is 3×10^8 m/s.
   (a) (5%) In which direction is the wave propagating? Choose <u>one</u> among $+x$, $-x$, $+y$, $-y$, $+z$, and $-z$.
   (b) (5%) Along which direction is the electric field of the wave? Choose <u>one</u> among x, y, and z.
   (c) (5%) Find β (in rad/m)?
   (d) (5%) What is the wavelength of this wave?
   (e) (5%) If this wave enters a medium which has a refractive index greater than 1 (i.e. $n > 1$), which of the following quantities of the wave will remain unchanged? Choose <u>one</u> among 'speed', 'wavelength', 'frequency', and 'phase constant β'.

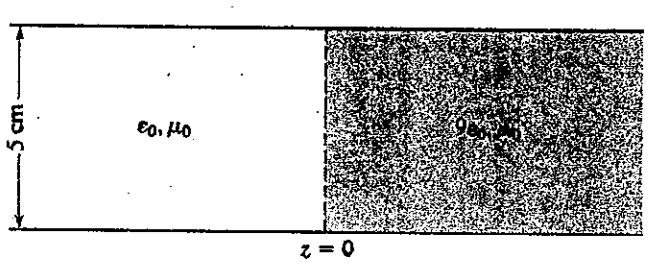
2. (15%) A parallel-plate transmission line consists of an arrangement of two perfect dielectrics in series, as shown by the transverse cross section in the figure below. Note that $\mu_1\varepsilon_1 = \mu_2\varepsilon_2$. Neglect fringing of fields and compute the values of L, C, and Z_0 of the line. (C is the capacitance per unit length; L is the inductance per unit length.)



3. (10%) The figure below shows two conductive plates which are parallel with each other. Each plate has a height t and a length L. The air gap size between them is g. Their overlap length is s. Both plates are mechanically fixed, and they cannot move. With a constant voltage V applied across the two plates, a mechanical force of electric origin is generated. What are the <u>magnitudes</u> of the x and y components of the force, respectively? (The permittivity of free space is ε_0.)



4. (30%) For the parallel-plate waveguide discontinuity in the figure below, find the power reflection coefficient for $f = 7500$ MHz for each of the following cases: (a) TEM mode; (b) $TE_{1,0}$ mode; and (c) $TM_{1,0}$ mode.



5. (20%) For a rectangular waveguide of dimensions $a = 3.75$ cm and $b = 1.25$ cm, and having a dielectric of $\varepsilon = 6.25\varepsilon_0$ and $\mu = \mu_0$, find <u>all propagating modes</u> for f = 5000 MHz, and, <u>for each mode</u>, find the values of f_c, β_z, λ_z, v_{pz}, and η_g.

試題隨卷繳回