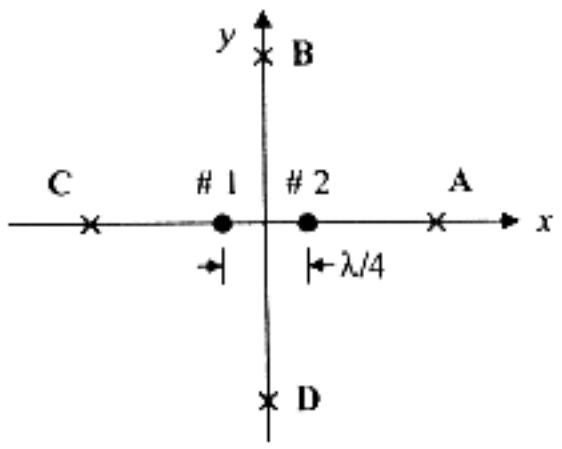
Problem 1: *(15 Points)*

Write the four Maxwell's equations in differential form. Which term in these equations denotes displacement current? How could Maxwell predict the existence of electromagnetic wave in free space derived from the four Maxwell's equations?

Problem 2: *(15 Points)*

Consider a two-element array as shown in the figure (top view). The antenna elements are identical half-wave dipoles. The current at the center of the first element is 1 A with $\phi = 0$, and that of the second element is 1 A with $\phi = 90°$. If only dipole 1 was present, the field on the x-y plane and 10 Km away from the origin would be 1 mV/m. What are the fields at points A, B, C, and D (all are 10 Km from the origin) when both dipole 1 and 2 are present?



Problem 3: *(10 Points)*

Explain the following terminologies: (a) phase propagation constant, (b) wave number, (c) skin depth, (d) attenuation constant, (e) parallel polarization (for a TEM wave obliquely incident to a plane surface).

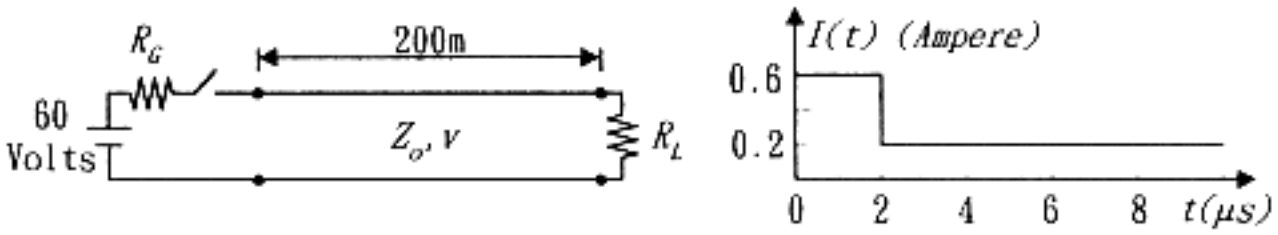
Problem 4: *(20 Points)*

A uniform plane wave in air impinges on a lossless dielectric material at a *30°* angle. The transmitted wave propagates in a *45°* direction with respect to the normal. (a) Find the relative dielectric constant of the dielectric material. (b) Find the critical angle for a total reflection. (c) If the incident angle of the plane wave is *60°*, find the wave number vector $\bar{k}$ for the transmitted wave? (d) If the E field of the incident wave is parallel to the interface, what is the Brewster angle for no reflection?

(背面仍有題目,請繼續作答)

Problem 5: *(20 Points)*

After closing the switch at $t = 0$ in the transmission line circuit shown, the current $I(t)$ is found by measurement to be as shown. Determine the wave velocity v and characteristic impedance Z_o of the transmission line, and the value of R_G and R_L.



Problem 6: *(20 Points)*

A $\lambda/4$ transformer of characteristic resistance R is inserted in a 300-Ω line at a distance d from the load Z_L. If $Z_L = 250 - j\ 150\ \Omega$ find d and R for a match. (Use Smith Chart and write down all steps of your reasoning)