

註：請將答案寫在答案卷，寫在題目卷不計分。選擇題及填充題的計算過程不計分。

1. (選擇題) The electric field of a uniform plane wave in free space is given by:

$$\mathbf{E} = E_0 \cos(2\pi \times 10^2 t - 4\pi y) \hat{x}$$

- (a) What is the direction of propagation of the wave? (3 points)
 (b) What is the direction of the electric field at $t = 0, y = 0$? (3 points)
 (c) What is the direction of the magnetic field at $t = 0, y = 0$? (3 points)
 (d) What is the direction of the Poynting vector? (3 points)

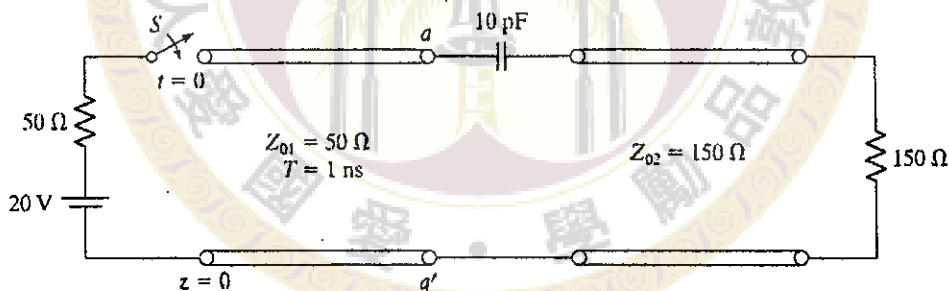
Please choose from the following answers:

- (1) $+\hat{x}$, (2) $-\hat{x}$, (3) $+\hat{y}$, (4) $-\hat{y}$, (5) $+\hat{z}$, (6) $-\hat{z}$

2. (填充題) An infinitely long, uniformly wound solenoid of radius R and having N turns per unit length carries a current I . Assuming air core ($\mu = \mu_0$),

- (a) inside the solenoid, the magnetic flux $\phi =$ _____. (4 points)
 (b) the inductance per unit length of the solenoid is _____. (4 points)
 (c) outside the solenoid, the magnitude of the magnetic field is $|\vec{H}| =$ _____. (4 points)

3. Let's consider the system shown below. It consists of a series capacitor of value 10 pF at the junction between two lines. Suppose no reflections occur at the two ends of the system. The capacitor is initially uncharged. Please find the value of line voltage at $z=0$ at the following times: (a) $t = 1.5$ ns; (b) $t = 4$ ns; and (c) $t = \infty$ (Total 15 points)



4. Please derive Brewster's angle and show it in the form of permittivity? (Total 10 points)
5. Suppose an impedance $22.5 + j 37.5\Omega$ is terminating a transmission line of $Z_0 = 75 \Omega$. The line is 1.64 cm long and the frequency is 146 MHz. The wave travels at a speed of 20 cm/ns. Please use the Smith chart to find out the transformed impedance for a 75 Ω line. (Total 10 points)
6. (填充題) The dimension of a rectangular metallic waveguide is 1.5 cm by 0.75 cm. Please write down the cutoff frequencies of the following modes. (Total 12 points = 4 points x 3)
 (a) $TE_{1,0}$: _____ GHz (c) $TE_{2,0}$: _____ GHz (d) $TM_{1,1}$: _____ GHz
7. In plotting the following patterns, please also point out the direction(s) for their maximum(s) and/or minimum(s).
 (a) A Hertzian dipole is placed at (0, 0, 0) with a current I flowing in the z -direction ($\theta=0$). Please plot its radiation pattern on the xz -plane. (5 points)
 (b) Please plot the radiation pattern of the Hertzian dipole on the xy -plane. (4 points)

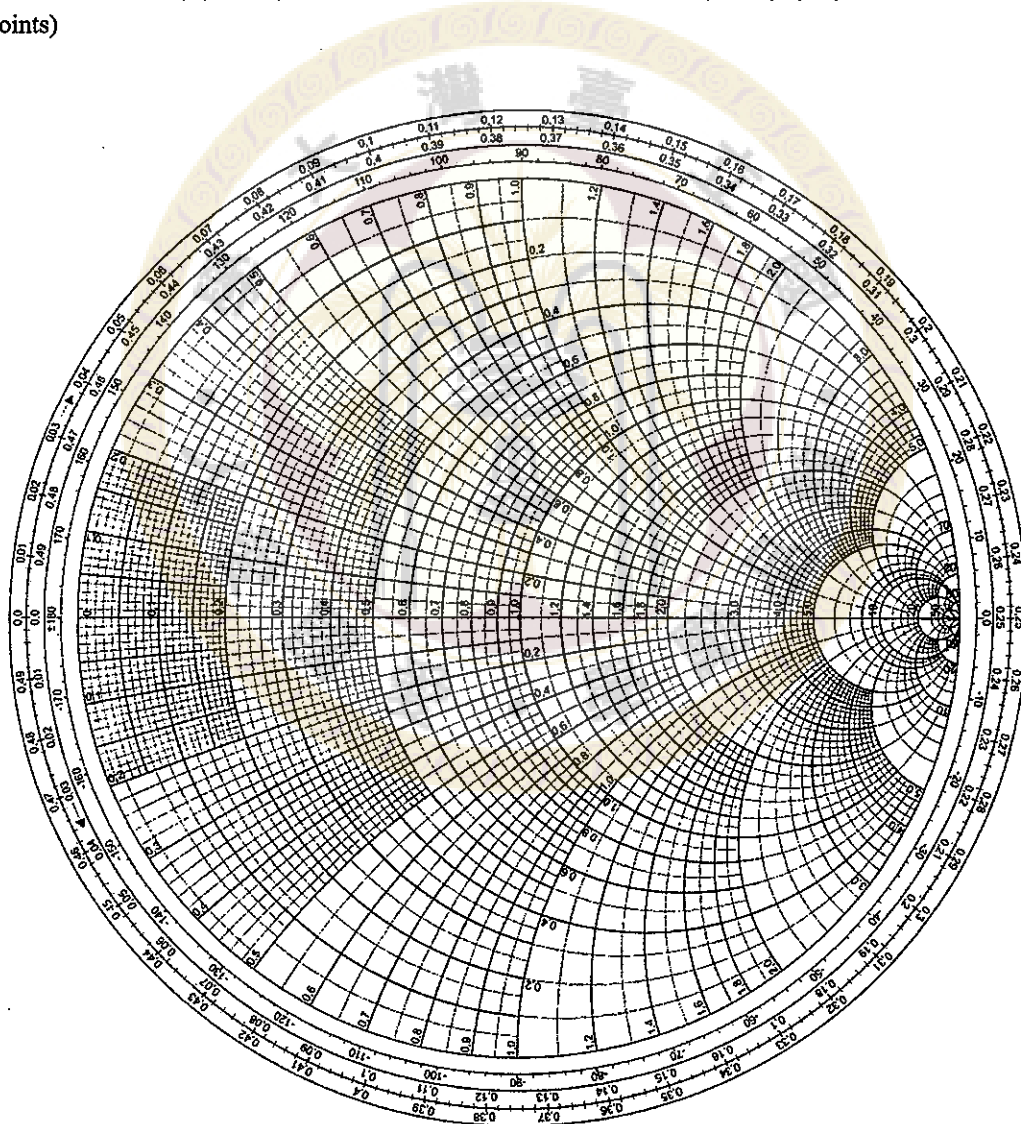
(c) Two Hertzian dipoles are placed at $(-\lambda/2, 0, 0)$ and $(\lambda/2, 0, 0)$. The current on the dipoles are equal and in phase. Please plot its group pattern on the xz -plane. (5 points)

8. A uniform plane wave of electric field \bar{E}_i and wavelength λ_0 is launched at an incident angle θ_i from free space on to a plane slab of thickness d and refractive index n .

(a) Please find the transmitted angle θ_t in the slab. (3 points)

(b) Let $\delta = 4\pi n d \cos \theta_t / \lambda_0$ and Γ be the reflection coefficient from free space on to the slab. Please find the transmitted electric field \bar{E}_t in terms of \bar{E}_i , δ , and Γ . (6 points)

(c) Let finesse $F = \pi|\Gamma|/(1 - \Gamma^2)$. Please find the transmission fraction $\xi = |\bar{E}_t|^2/|\bar{E}_i|^2$ in terms of δ and F . (6 points)



Smith chart

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