

國立臺北科技大學九十八學年度碩士班招生考試

系所組別：2401 2402 光電工程系碩士班不分組

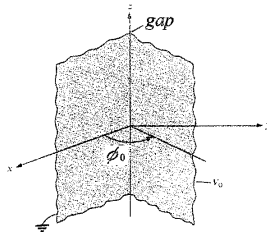
第二節 電磁學 試題

第一頁 共一頁

注意事項：

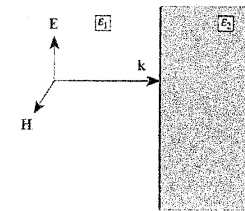
1. 本試題共 7 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Consider two concentric spherical shells, of radii a and b . Suppose the inner one carries a charge q , and the outer one charge $-q$ (both of them uniformly distributed over the surface). Calculate the energy of this configuration. [15%]
2. A uniform line charge λ is placed on an infinite straight wire, a distance d above a grounded conducting plane. (Let's say the wire turns parallel to the x -axis and directly above it, and the conducting plane is the xy plane.) Find the charge density σ induced on the conducting plane. [15%]
3. Semi-infinite conducting planes $\phi = 0$, and $\phi_0 = \pi/6$ are separated by an infinitesimal insulating gap as shown in the figure. If $V(\phi = 0) = 0$, and $V_0(\phi_0 = \pi/6) = 100$ V, calculate V and \vec{E} in the region between the planes. [15%]

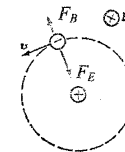


4. Suppose there did exist magnetic monopoles. How would you modify Maxwell's equations and the force law, to accommodate them? [10%]
(Explain your modification as detail as you can.)

5. Find the vector potential above and below the xy plane with surface current density $\vec{J}_s = J_0 \hat{x}$, flowing over the xy plane. [15%]
6. A monochromatic plane wave of frequency ω propagates through a nonpermeable ($\mu = 1$) insulating medium with dielectric constant ϵ_1 . The wave is normally incident upon an interface with a similar medium with dielectric constant ϵ_2 , as shown in the figure.
 - (a) Derive the boundary conditions for the electric and magnetic fields at the interfaces. [10%]
 - (b) Find the fraction of incident energy that is transmitted to the second medium. [10%]



7. Briefly answer the following questions.
 - (1) A positively charged conductor A is moved toward an isolated uncharged conductor B. Is the potential of conductor B increased, unchanged, or decreased? Explain your answer. [3%]
 - (2) A parallel-plate capacitor is connected to a battery. Would you do positive, zero, or negative work as you insert a dielectric slab between the plates? [2%]
 - (3) In Bohr's model of hydrogen atom, an electron is assumed to travel in circular orbit around a proton. If a magnetic field is applied as shown in the figure, is the angular frequency of the orbital motion increased, the same, or decreased? (Assume the radius of the orbit is unchanged.) [2%]



- (4) Find the ratio of w_E/w_m for an EM wave at any point in free space. Where w_E and w_m are energy densities of electric and magnetic fields. [3%]

2401-1