

國立中正大學九十四學年度碩士班招生考試試題

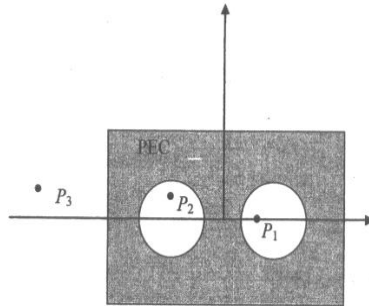
系所別：光機電整合工程研究所

科目：電磁學

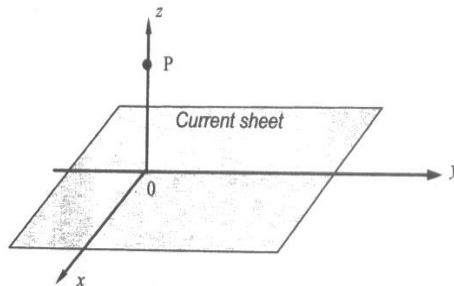
第 3 節

第 1 頁，共 2 頁

1. (30%) A perfect-electric-conducting (PEC) structure with two cavities is shown in the following figure. A point charge  $+Q$  is located at  $P_1$ .
- (a) Plot schematically the induced charge distribution inside the volume and on the surface of PEC.
- (b) Assume a positive test charge is placed at  $P_2$ . Does it experience a force? Describe your reasons.
- (c) If the test charge is placed at  $P_3$ , does it experience a repulsive force? Explain.



2. (20%) A uniform surface current sheet  $\vec{J}_s = \hat{y}J_0$  (A/m) with an infinite extent in the  $x$ - $y$  plane flows in the  $y$  direction.
- (a) Calculate the generated magnetic field intensity.
- (b) If the point charge with an initial velocity  $\vec{v}(0) = \hat{y}u_0$  is injected from the point P, plot the trajectory. Neglect the gravity effect.



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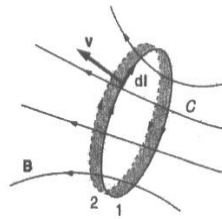
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第 3 節

第 2 頁，共 2 頁

3. (20%) Show the total electromotive force (emf) induced in a closed loop is:

$$e = -\frac{d}{dt} \int_S \vec{B} \cdot d\vec{S}.$$



4. (30%) Consider the case of a sinusoidal current in a homogenous conducting half-space. Let the angular frequency of the current be  $\omega$  and let the medium have conductivity  $\sigma$  and permeability  $\mu$ . The current density vector is parallel to the boundary surface, say,  $\vec{J} = J_z \hat{e}_z$ .
- (a) What are the Maxwell equations for this system? Express them in the phasor form.
- (b) What is the dependence of  $J_z$  on the distance from the surface?
- (c) What is the expression of the so-called skin depth?

