淡江大學 96 學年度轉學生招生考試試題

系別:物理學系三年級

科目:電

本試題共

※ 請詳細列出各步驟及計算過程,否則不予計分.

※ 毎題 20 分

Fundamental constants:

Permittivity of free space

 $\varepsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{Nm}^2$

Permeability of free space $\mu_0 = 4\pi \times 10^{-7} \text{ N/A}^2$

- 1. Suppose you have two infinite straight-line charges with line charge density $+\lambda$, a distance d apart, moving along at a constant speed v as shown in <u>Fig. 1</u>.
 - (a) Find the electric field and the electric force per unit length on top wire. Is this force attractive or repulsive?
 - (b) Find the magnetic field and the magnetic force per unit length on top wire. Is this force attractive or repulsive?
 - (c) Find speed v that have to be in order for both forces are equal in magnitude?
- 2. Two electrostatic fields have the forms:

$$\vec{E}_a = k [(y^2)\hat{x} + (2xy+z^2)\hat{y} + (2yz)\hat{z}]; \quad \vec{E}_b = k [(xy)\hat{x} + (2yz)\hat{y} + (3xz)\hat{z}]$$

Here k is a constant with the appropriate units.

- (a) Are they possible electrostatic field? Why?
- (b) For the possible ones, find the potential V at (x, y, z), using the origin as your reference point.
- (c) For the possible ones, find the energy density stored in the space.
- A circular loop of radius R, carries a steady current I.
 - (a) Find the magnetic field a distance z above the center of the loop.
 - (b) Find the magnetic moment of the loop.
- A metal strip of length L pivoted at one end is rotating freely with an angular velocity ω in a uniform magnetic field $\mathbf{B} = \mathbf{B} \hat{z}$ as shown in <u>Fig. 2</u>.
 - (a) What is the induced emf between the two ends (a and b) of the strip?
 - (b) Which end of the strip is positive with respect to the other end?
- 5. (a) What is Poynting's theorem? Write equation for it and give its physical meaning for each term in it.
 - (b) Write down the Poynting vector, and give its physical meaning.

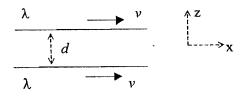


Fig. 1.

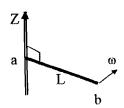


Fig. 2.