

國立中央大學97學年度碩士班考試入學試題卷

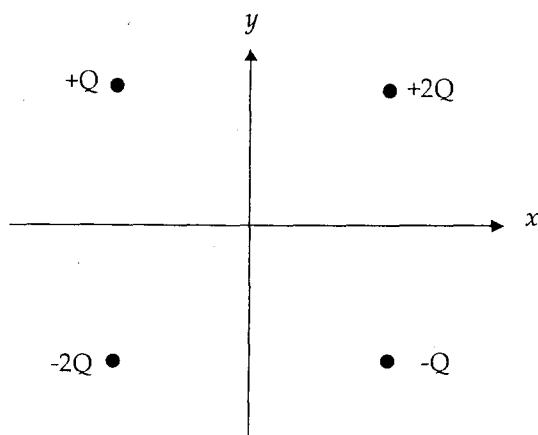
所別：遙測科技碩士學位學程碩士班 科目：電磁學 共 3 頁 第 1 頁

*請在試卷答案卷(卡)內作答

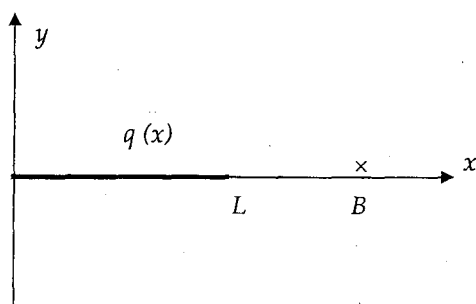
電磁學 試題 共 6 題, 總分 100 分

共 3 頁

1. Four point charges $+Q$, $+2Q$, $-Q$, and $-2Q$ are placed at the coordinates $(-2, +2)$, $(+2, +2)$, $(+2, -2)$ and $(-2, -2)$ respectively. Calculate the magnitude of the E-field at the origin. (10%)



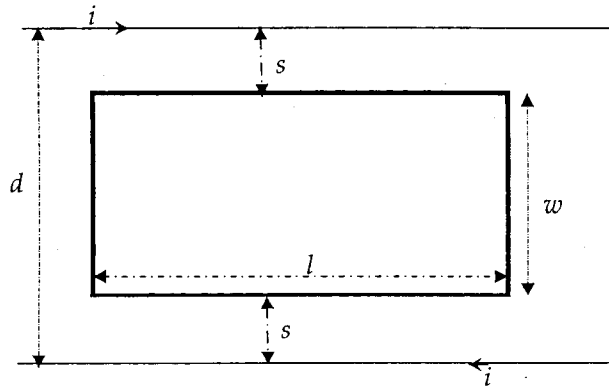
2. A line charge extends from $x=0$ to $x=L$ and has density $q(x) = q_0 x \text{ Cm}^{-1}$. Find the E-field at the point B ($>L$) on the axis. (10%)



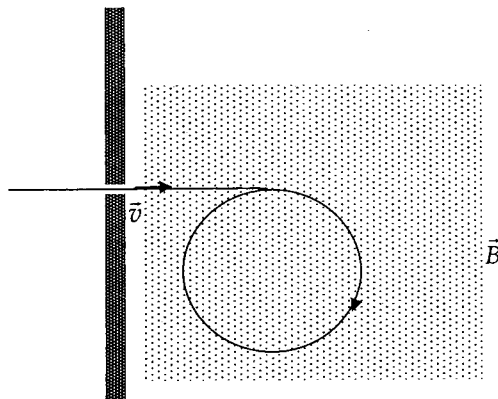
3. A rectangular loop of wire of length l and of width w lies in the plane and is centered between two very long, parallel wires separated at distance d . A time-dependent current $i = I_0 \sin \omega t$ passes through the wires, as indicated in the figure. The loop is at a distance s from the wire. (20%)
- (a) Calculate the total magnetic flux through the loop. (10%)
- (b) Find the induced electric field in the rectangular loop. (10%)

參考用

注意：背面有試題



4. A beam of protons is collimated through a narrow slit. The proton enters a region where there is a uniform magnetic field \vec{B} coming out of the paper. The velocity \vec{v} of the protons is perpendicular to \vec{B} . The mass of proton is 1.7×10^{-27} kg with charge of 1.6×10^{-19} C. Assuming that $|\vec{v}| = 3 \times 10^6$ m/s and $|\vec{B}| = 2$ Tesla. Find the radius of their circular path and frequency. (20%)
(Hint: use also Newton's second law)



5. A time-harmonic plane wave traveling in a source-free free space is given as follows:

$$\vec{E} = (4\hat{y} + 3\hat{z})e^{-j(3y-4z)} \text{ mV/m}, \quad j = \sqrt{-1},$$
 where e^{-jaz} means outgoing wave traveling along +z-axis. Assuming that y

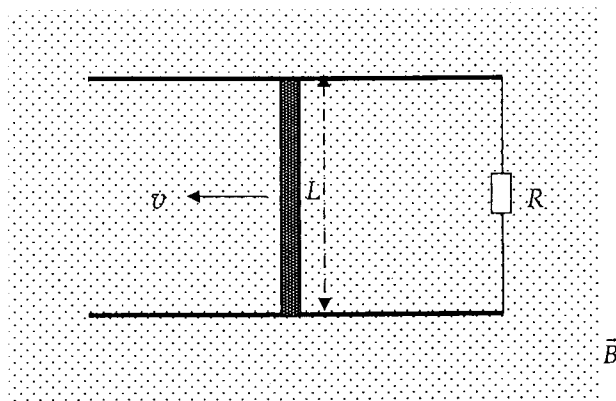
注意：背面有試題

and z represent their respective distances in meters. (25%)

Determine:

- (a) the angle of the propagation direction relative to the $+z$ -axis, (5%)
- (b) the wavelengths of the wave along y and z directions, (3%)
- (c) the phase velocities along y and z directions, (3%)
- (d) the energy velocities along y and z directions, (3%)
- (e) the frequency of the wave, (3%)
- (f) the polarization of the wave, (3%)
- (g) the associated magnetic field intensity (5%)

6. A bar of length L and of mass m slides along two fixed metal conductors connected by a resistor of resistance R , where there is a uniform magnetic field \vec{B} coming out of the paper as shown in the figure. If at time $t=0$ an impulse causes the bar to move with an initial velocity v_0 . Find the velocity $v(t)$ of the moving bar. (neglect any resistance in the bar and conductors and assume a frictionless contact between the bar and conductors). (15%)



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