國立中央大學八十四學年度碩士班研究生入學試題卷

所別：大氣物理研究所　　組　科目：電磁學　　共 1 頁 第 1 頁

1. A perfect conducting sphere of radius R carries a total charge Q.
(a) what is the charge distribution ? (5%)
(b) what is the electrostatic pressure on the surface ? (10%)

2. Two infinitely long wires both parallel to the z-axis carry charge densities $+\lambda, -\lambda$, respectively. The $+\lambda$ line charge is located at $x=a, y=0$ and the $-\lambda$ line charge is located at $x=-a, y=0$.
(a) find the electric potential and field at any point. (10%)
(b) find the equipotential surface of the configuration. (5%)
(c) find the electrostatic energy density. (5%)

3. A spherical conductor of radius a, carries a charge Q. It is surrounded by linear dielectric material permittivity ε, out to a radius R. Find the energy of this configuration. (15%)

4. A circular loop of wire with radius a lies in the yz plane, centered at $x=0, y=0, z=0$ and carries a current I running clockwise as viewed from the positive x-axis.
(a) what is the magnetic dipole moment ? (5%)
(b) what is the magnetic field at points on the x-axis. (10%)
(c) what is the approximate magnetic field at points far from the circle.(10%)

5. Consider a plane electromagnetic wave in a linear dielectric medium with permittivity ε, permeability μ. The electric field of the wave,

$$\vec{E} = E_0(\hat{x}\cos(\omega t - kz) + \hat{y}\sin(\omega t - kz))$$

where E_0 is a real constant value.
(a) what is the magnetic field of the wave. (5%)
(b) find the average energy density u and the average Poynting vector $\vec{S}$ of the wave. (10%)
(c) show that u moves along with the wave. (5%)
(d) find the polarization vector of the wave in the plane of constant phase. (5%)