淡江大學九十一學年度日間部轉學生招生考試試題

系別：物理學系三年級　　科目：電　磁　學

准帶項目請打「○」否則打「×」
計　算　機
×

★ 請詳列或敘述計算過程，否則不予計分。

1. A straight-line segment of length L, carries a uniform line charge density λ.
   (a) Find the electric field a distance z above one end of the line as shown is Fig. 1. (10%)
   (b) What field would you expect for the case $z \gg L$. Why? (5%)

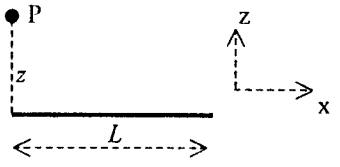

Fig. 1

2. A metal sphere of radius R, carrying charge Q, is surrounded by a thick concentric metal shell (inner radius a, outer radius b, as shown in Fig. 2). The shell carries no net charge.
   (a) Find the surface charge density σ at R, at a, and at b. (6%)
   (b) Find the potential at the center, using infinity as the reference point. (10%)
   (c) Now the outer surface is touched to a grounding wire. How do you answers to (a) and (b) change? (9%)

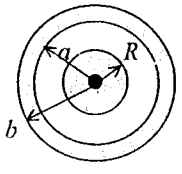

Fig. 2

3. A "pure" dipole p is situated at the origin, pointing in the z direction.
   (a) What is the force on a point charge Q at $(a, 0, 0)$ (Cartesian coordinates)? (6%)
   (b) What is the force on Q at $(0, 0, a)$? (6%)
   (c) How much work does it take to move Q from $(a, 0, 0)$ to $(0, 0, a)$? (6%)

4. 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. (10%)
   (b) Find the magnetic moment of the loop. (5%)

5. A very long solenoid, consisting of n closely wound turns per unit length on a cylinder of radius R and carrying a steady current I.
   (a) Find the magnetic field of the solenoid. (5%)
   (b) Find the self-inductance per unit length of the solenoid. (5%)
   (c) Find the energy stored in a section of length l of the solenoid. (5%)

6. At the interface between one linear magnetic material and another magnetic field lines bend (see Fig. 3). Show that $\tan\theta_2 / \tan\theta_1 = \mu_2 / \mu_1$, assuming there is no free current at the boundary. (12%)

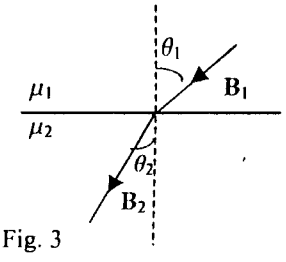

Fig. 3