1. Write down the Maxwell's equations in matter and boundary conductions. (10%)

2. Two point charges, 3q and –q, are separated by a distance a, as shown in Fig. 1. Find (a) the monopole moment, (b) the dipole moment, and (c) the approximate potential at a large distance. (15%)

3. A constant potential V_0 is specified on the surface of a hollow sphere, of radius R. Find the potential inside and outside the sphere. (20%)

4. A uniformly magnetized sphere with $\vec{M} = M\hat{z}$, as shown in Fig. 2. Find the (a) bound volume current, (b) bound surface current, (c) magnetic field, $\vec{B}$, inside the sphere and (d) $\vec{H}$. (note that

$$\vec{H} \equiv \frac{\vec{B}}{\mu_0} - \vec{M}$$) (20%)

5. A long coaxial cable carries current I (The current flows down the surface of the inner cylinder, radius a, and back along the outer cylinder, radius b. Two cylinders are held at potential difference V), Fig. 3. Calculate (a) the electric field and (b) the magnetic field between the cylinders. Find (c) the magnetic energy stored in and (d) the self-inductance of a section of length *l*. Calculate (e) the Poynting vector and (f) the power transported down the coaxial cable and (g) the electromagnetic momentum stored in the fields in a section of length *l*. (35%)
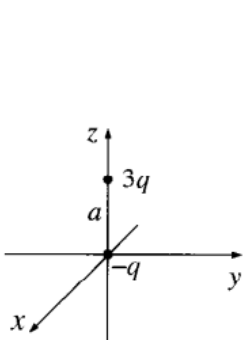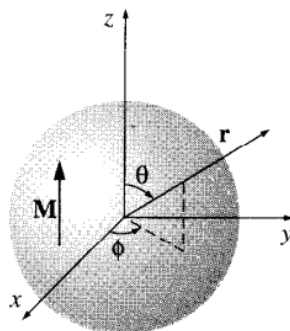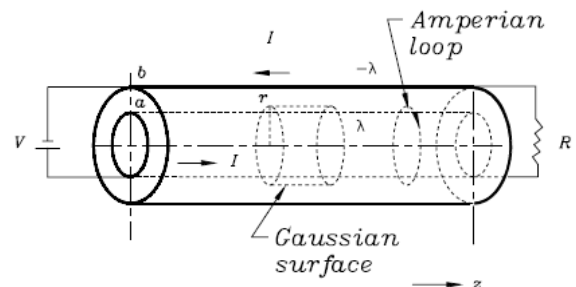

Fig. 1　　　　　　　　Fig. 2　　　　　　　　Fig. 3