淡江大學九十四學年度碩士班招生考試試題 35-1

系別：物理學系　　　　　科目：電　磁　學

1. Two spheres, each of radius R and carrying uniform charge densities $+\rho$ and $-\rho$, respectively, are placed so that they partially overlap as shown in Fig.1. Call the vector from the positive center to the negative center **d**. Show that the field in the region of overlap is a constant and find its value.　　　15%

2. A sphere of radius R carries a charge density $\rho = k\,r$ (where k is a constant) . Find the electric energy of this configuration.　　　10%

3. A battery of emf ε and internal resistance r is hooked up to a variable resistance R. If you want to deliver the maximum possible power to the variable resistance R, what value of R should you choose?　　　15%

4. Two metal objects are embedded in weakly conducting material of conductivity σ as shown in Fig.2. Show that the resistance R between them is related to the capacitance C of the arrangement by $R = \varepsilon_0 / (\sigma C)$.　　　15%

5. A phonograph record of radius R, carrying a uniform surface charge σ, is rotating at constant angular velocity ω. Find its magnetic dipole moment.　　　10%.

6. A metal disk of radius a rotates with angular velocity ω about a vertical axis, through a uniform magnetic field **B**, pointing up. A circuit is made by connecting one end of a resistor to the axle and the other end to a sliding contact, which touches the outer edge of the disk as shown in Fig.3. Find the current in the resistor.　　　15%

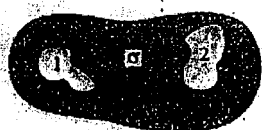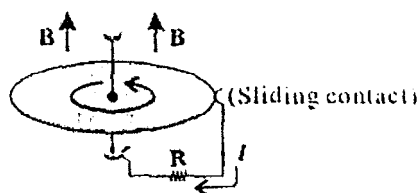7. Write down the four Maxwell's Equations in free space.　　　20%.

Fig.1　　Fig.2　　Fig.3