所別： 太空科學研究所 碩士班 不分組(一般生)　　　共 1 頁　第 1 頁

太空科學研究所 碩士班 不分組(在職生)

科目： 電磁學

本科考試禁用計算器　　　　　　　　　　　　　＊請在答案卷　　內作答

1. Find the electric field inside and outside a uniformly charged solid sphere of radius R (total charge is q), and the corresponding electric potential.(Use infinity as your reference point)(20%)

2. Describe the Helmholtz theorem. (20%)

3. Evaluate the integral

$$J = \int_{\gamma} (r^2+2)\nabla \cdot (\frac{\hat{r}}{r^2})d\tau,$$

where γ is a sphere of radius R centered at the origin, and $\hat{r}$ is a unit vector.(10%)

4. When you polarize a neutral dielectric, please prove that the total bound charge vanishes. (10%)

5. A capacitor C has been charged up to potential V_o; at time t=0, it is connected to a resistor R, and begin to discharge, as shown in the following figure.
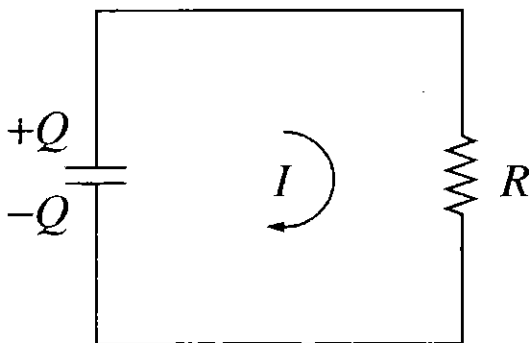
(a) Determine the charge on the capacitor as a function of time, Q(t). What is the current through the resistor?(10%)

(b) What was the original energy stored in the capacitor? Confirm that the heat delivered to the resistor is equal to the energy lost by the capacitor.(10%)

6. IF we start with zero current and build it up to a final value I, the work done is $W=\frac{1}{2}LI^2$, where L is the self inductance. Please show that the work done can also be written as $W=\frac{1}{2\mu_o} \int_{\text{all space}} \mathbf{B}^2 \, d\tau$.(20%)