國立中央大學 109 學年度碩士班考試入學試題

所別：　太空科學研究所 碩士班 不分組(一般生)
　　　　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　　計算題需計算過程，無計算過程者不予計分　　＊請在答案卷 (卡) 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. In magnetostatics, $\vec{A}(\vec{r}) = \frac{\mu_0}{4\pi} \int \frac{\vec{J}(\vec{r}')}{n} d\tau'$, where $n = |\vec{r} - \vec{r}'|$. Prove that $\nabla \cdot \vec{A} = 0$. (15%)
(Hint: $\nabla \cdot (f\vec{A}) = f(\nabla \cdot \vec{A}) + \vec{A} \cdot \nabla f$)

3. When you polarize a neutral dielectric, please prove that the total bound charge vanishes. (15%)

4. A capacitor C has been charged up to potential V_0; at time t=0, it is connected to a resistor R, and begin to discharge, as shown in the following figure.
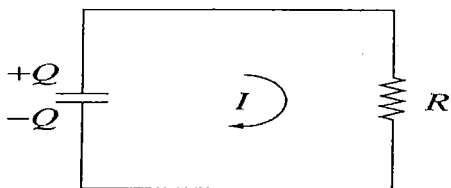
(a) Determine the charge on the capacitor as a function of time, Q(t). What is the current through the resistor? (10%)
(b) What was the original energy stored in the capacitor? Confirm that the heat delivered to the resistor is equal to the energy lost by the capacitor. (10%)

5. Suppose the entire region below the plane z=0 in the following figure is filled with uniform linear dielectric material of susceptibility χ_e. Calculate the force on a point charge q situated a distance d above the origin. (15%)
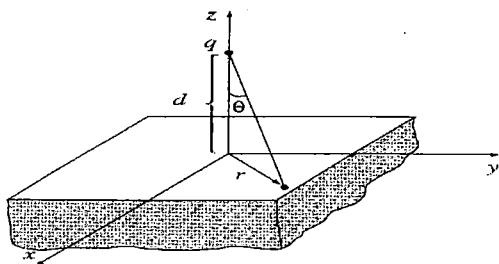
6. Prove that the solution to Laplace's equation in some volume v is uniquely determined if V is specified on the boundary surface S. (15%)