

國立中央大學 110 學年度碩士班考試入學試題

所別： 太空科學與工程學系 碩士班 不分組(一般生)
太空科學與工程學系 碩士班 不分組(在職生)

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科目： 電磁學

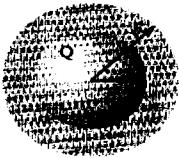
本科考試禁用計算器

*請在答案卷(卡)內作答

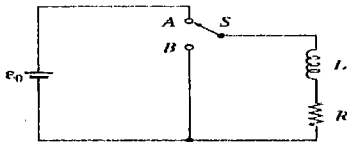
※計算題需計算過程，無計算過程者不予計分

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 the reference point) (20%)

2. A metal sphere of radius a carries a charge Q . It is surrounded, out to radius b , by linear dielectric material of permittivity ϵ . Find the potential at the center (relative to infinity) ,the bound volume charge density, and the bound surface charge density at the inner and outer surfaces, respectively. (20%)



3. Suppose the circuit has been connected for a long time when suddenly, at time $t=0$, switch S is thrown from A to B , bypassing the battery.



- (a) What is the current at any subsequent time t ? (5%)
- (b) What is the total energy delivered to the resistor? (10%)
- (c) Show that this is equal to the energy originally stored in the inductor. (5%)

4. A large parallel-plate capacitor with uniform surface charge σ on the upper plate and $-\sigma$ on the lower is moving with a constant speed v , as shown in the following figure.



- (a) Find the magnetic field between the plates and also above and below them.(5%)
- (b) Find the magnetic force per unit area on the upper plate, including its direction.(5%)
- (c) At what speed v would the magnetic force balance the electrical force?(10%)

5. 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 $\nabla \cdot \vec{A} = 0$. (20%)

(Hint: $\nabla \cdot (f\vec{A}) = f(\nabla \cdot \vec{A}) + \vec{A} \cdot \nabla f$)