

系列：物理學系三年級

科目：電 磁 學

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|-----------------|--------|
| 准帶項目請打「○」否則打「×」 | |
| × | 簡單型計算機 |

節次： 7 月 14 日 第 5 節
本試題共 1 頁

※ 請詳細推導與配置相關圖形，否則不予給分！
※ 每題25分

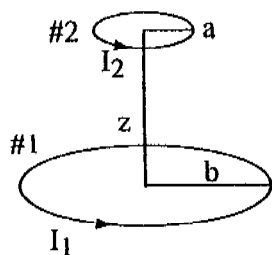
- A small loop of wire (radius a) lies a distance z above the center of a large loop (radius b). The planes of the two loops are parallel, and perpendicular to the common axis. [$a \ll b$]

 - Suppose current I_1 flows in the big loop, find the flux Φ_2 through the little loop.
 - Suppose current I_2 flows in the little loop, find the flux Φ_1 through the big loop.
 - Find the mutual inductances, and confirm that $M_{12} = M_{21}$.
- At $t = 0$, the switch is closed and we assume that there is no charge on the parallel-plate capacitor. The plates of the capacitor are circular and their radii are b .

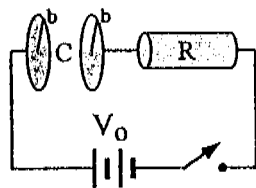
 - Determine $Q(t) = ?$ and $I(t) = ?$
 - Find the total energy output of the battery $W = ?$
 - Find the final energy stored in the capacitor $W = ?$.
 - Find the expression for $B(r) = ?$ at a point inside the capacitor at radius r from the center, when the capacitor is being charged. ($r < b$)
 - Find the expression for $B(r) = ?$ at a point outside the capacitor at radius r from the center, when the capacitor is being charged. ($r > b$)
- A thick spherical shell (inner radius a , outer radius b) is made of dielectric material with a "frozen-in" polarization $\vec{P}(\vec{r}) = \frac{k}{r} \hat{r}$, where k is a constant and r is the distance from the center.

 - Locate all the bound charges $\sigma_b = ?$ and $\rho_b = ?$
 - Use Gauss's law to find $\vec{E} = ?$ in all three regions.
 - Use Gauss's law to find $\vec{D} = ?$, and then get $\vec{E} = ?$
- 如下圖所示，球殼電荷密度均勻 σ 、半徑 R 、電量 Q 。

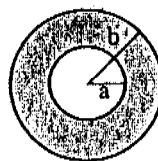
 - 求外部與內部的電場強度 $\vec{E} = ?$ [方法：高斯定律]
 - 求外部與內部的 $\vec{\nabla} \times \vec{E} = ?$
 - 寫出 \vec{E} 的邊界條件，並驗證！
 - 求 energy stored in the configuration $W = ?$



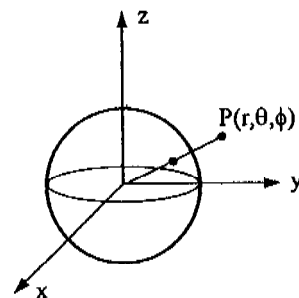
第 1 題



第 2 題



第 3 題



第 4 題