

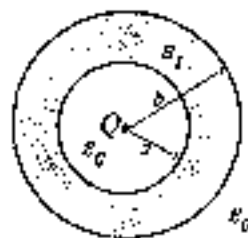
1. (20 points)

(a) Write down Maxwell's equations in integral form.

(Including the name of each law, the names of the variables and their units.)

(b) Write down the boundary conditions.

2. (15 points)

A charge Q is located at the center of a dielectric sphere as shown in the figure.Find and plot the electric flux density, electric field intensity, potential, polarization, and polarization charge density as functions of the distance r from the origin.

3. (15 points)

(a) Find the magnetic field intensity at the center of a square loop carrying a current I . The side of the square loop is a meters long.(b) If a circular loop that has radius b and that carries a current I produces the same magnetic field strength at its center, find the ratio of b to a .

(背面仍有題目,請繼續作答)

(15%) 4. 請列舉三種測量半導體電阻係數(resistivity)的方法，並說明如何測量。

(20%) 5. 證明半導體中

(i) 三度空間中，電子之 density of state

$$N(E) = 4\pi \left(\frac{2m_n^*}{h^2} \right)^{3/2} E^{1/2}$$

(ii) 若電子被限制在二度空間中活動，則其 density of state

$$N(E) = \frac{m_n^*}{\pi \hbar^2}$$

其中 m_n^* 為電子有效質量， h 為 Planck's constant， \hbar 為 reduced Planck's constant。

(15%) 6. 簡答題

- (i) 為何一 photodetector 操作時加反向偏壓，而不加正向偏壓？
- (ii) 列舉二種解決方法，使某些原具有 indirect bandgap 的材料，可以成為可發光的材料。
- (iii) 一場效電晶體，其線性區(linear region)與飽和區(saturation region)之互導值(transconductance)在應用上有何不同？