編號： 163 國立成功大學 107 學年度碩士班招生考試試題

系　　所：生物醫學工程學系

考試科目：電磁學 考試日期：0205，節次：2

※ 考生請注意：本試題可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Consider a simple model of the Helium atom containing two protons at the center, and two electrons moving around the protons with a radius of 0.5×10^{-10} m in a free space. The charges of electron and proton are the same but in opposite sign. Assume that the two electrons are always in opposite position. (a) Please calculate the force between the two electrons, and the force between one electron and two proton, (b) Neglecting all the other forces within atom, please calculate the angular velocity of the electrons to stay at this given radius. (20%)

2. There are three vector fields in a free space: $\mathbf{A}_1 = x\,\mathbf{a}_x$, $\mathbf{A}_2 = 6\,\mathbf{a}_x$, and $\mathbf{A}_3 = \mathbf{A}_1 + \mathbf{A}_2$. (a) Please test which are electrostatic fields, and (b) Find the equivalent charge density for those electrostatic fields. (20%) (Note: $\mathbf{a}_x$ is an unit vector in x-axis.)

3. Please calculate the approximated electric field intensity of a configuration as shown in Fig. 1. (20%) (Note: $\mathbf{a}$ is an unit vector in z-axis.)

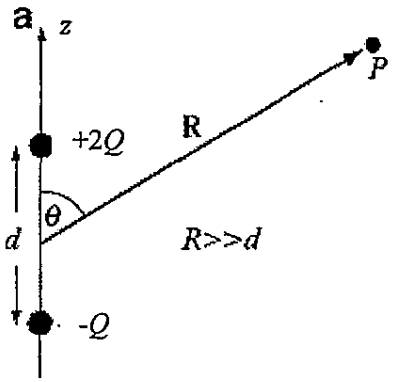

Fig. 1

(Some constants of free space: Velocity of light $c = 3 \times 10^8$ m/s, Permittivity $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m, Permeability $\mu_0 = 4\pi \times 10^{-7}$ H/m, and Charge of electron: -1.6×10^{-19} C.)

4. Three coils (coil 1 with N_1 turns, coil 2 with N_2 turns, and coil 3 with N_3 turns) are wound on a toroidal core with properties and dimensions as shown in Fig. 2. Assume $a >> (b - a)$ and all three coils are uniformly wound around the core. Please calculate (a) The self-inductance of each of the three coils, and (b) the mutual inductances between coils 1 and 2, between coils 2 and 3, and between coils 1 and 3. (20%)

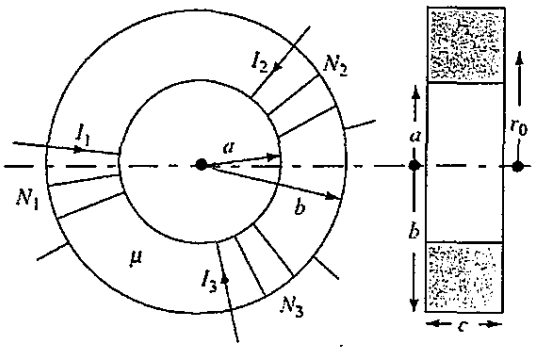

Fig. 2

5. Please detailedly describe your derivations of a wave equation in terms of the electric scalar potential V in a medium with μ and ε based on Maxwell's equations. (20%)