系所組別： 生物醫學工程學系乙組

考試科目： 電磁學

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. A charge Q is distributed uniformly over an L x L square plate. Determine the electric potential V and the electric field **E** at a point on the axis perpendicular to the plate and through its center. (20%)

2. In a vacuum-tube diode, electrons are emitted from a hot cathode at zero potential and collected by an anode maintained a potential V_0, resulting in a convection current flow. Assuming that the cathode and the anode are parallel conducting plates and that the electrons leave the cathode with a zero initial velocity, find the relation between the current density J and V_0. Define your symbols and coordinate system with clear descriptions and figure. (20%)

3. A ground connection is made by burying a hemispherical conductor of radius 25 mm in the earth with its base up, as shown in Fig. 1. Assuming the earth conductivity is about 10^{-6} S/m, find the resistance of the conductor to far-away points in the ground. (20%)

4. A current I flows in a long solenoid with n closely wound coil-turns per unit length. The iron core has a cross-sectional area S, and permeability μ. Determine the force acting on the core if it is withdrawn to the position shown in Fig. 2. (15%)

5. A light ray is incident from air obliquely on a transparent sheet of thickness d with an index of refraction n, as shown in Fig. 3. The angle of incident is θ_i. Find (a) θ_t, (b) the distance l_1 at the point of exit, and (c) the amount of the lateral displacement l_2 of the emerging ray. (15%)

6. A hollow circular cylindrical cavity resonator is to be constructed of copper such that this length d equals its diameter $2a$. (a) Determine a and d for a resonant frequency of 10 GHz at the TM_{010} mode. (b) Find the quality factor Q of the cavity at resonance. (10%) (The conductivity of copper is 5.8×10^7 S/m. For free space, the intrinsic impedance is 377 W, the permittivity is $1/36\pi \times 10^{-9}$ F/m, and the permeability is $4\pi \times 10^{-7}$ H/m.)

(背面仍有題目,請繼續作答)

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Fig. 1

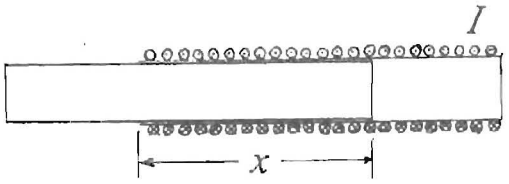

Fig 2

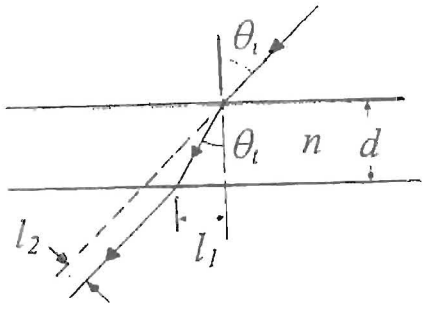

Fig. 3