

國立中央大學八十八學年度碩士班研究生入學試題卷

所別： 大氣物理研究所 不分組 科目： 電磁學 共 / 頁 第 / 頁

[20%] 1. Short questions and problems.

- Derive Coulomb's law from Gauss's law.
- Give boundary conditions for electrostatic field.
- Write/state Poisson's and Laplace's equations.
- Write/state Ohm's law.
- Write/state Joule's law.
- Write/state the integral form of Maxwell's equations.
- Express the Biot-Savart law.
- Express Lorentz's force equation.
- State polarization of waves.
- State Doppler effect.

[15%] 2. If a thundercloud is above the ridge and ravine, give the relationship between electric field, potential and charge density on the ridge and those in the ravine. Explain.

[20%] 3. 一考慮柱面座標系，在 $z=0$ 處有一個無窮大的平面導體，在 $r=0, z=a$ 處有一個點電荷，帶電量為 Q 。請問此點電荷在導體面上任意一點 $(r, \theta, z=0)$ 處，所造成的電場 (electric field) \vec{E} 以及感應電荷面密度 (induced surface charge density) σ 各為多少？（向量的解答，請務必註明其大小與方向）

[20%] 4. 一考慮直角座標系，在 $z=0$ 處有一個無窮大的平面導體，在 $y=0, z=a$ 處有一個無窮長的直線電流，其電流密度的大小與方向為 $J_0 \hat{x}$ 。請問此直線電流在導體面上任意一點 $(x, y, z=0)$ 處，所造成的磁場 (magnetic field) \vec{B} 以及感應面電流密度 (induced surface current density) \vec{j} 各為多少？（向量的解答，請務必註明其大小與方向）（若導體厚度為 h ，則面電流密度 \vec{j} 與電流密度 \vec{J} 的關係式為 $\vec{j}h = \vec{J}$ ）

[10%] 5. 試由 Maxwell's equation 推導電磁波在真空中傳播之 wave equation。

[15%] 6. A copper strip of length of 2 meters pivoted at the midpoint is rotating with an angular velocity $\vec{\omega} = 6\pi \times 10^3 \hat{z}$ rad/s in a uniform magnetic field $\vec{B} = (3\hat{x} + 4\hat{z})$ Tesla. Determine (a) the induced emf between the midpoint and one of the ends of the strip, and between the two endpoints. (b) Evaluate the charges at the midpoint and the two ends.