國立中央大學九十一學年度碩士班研究生入學試題卷

所別：太空科學研究所　不分組　科目：太空物理　共 1 頁　第 1 頁

太空物理

1. Consider a 2D magnetic field of $\vec{B} = x\hat{x} - y\hat{y}$.
(a) Show that this field satisfies $\nabla \cdot \vec{B} = 0$. (5%)
(b) Calculate the field line equation and draw a few curves on the (x, y) plane. (10%)

2. For a particle distribution of

$$f(\vec{v}) = A\exp\left[-\frac{1}{2}m[(v_x - u)^2 + v_y^2 + v_z^2]\right]$$

(a) What is the meaning of u ? (5%)
(b) What is the meaning of kT ? (5%)
(c) How many kinds of energies are there in a system of many charged particles embedded in electric and magnetic fields? (5%)

3. Under what circumstance, magnetic field lines are also equipotential (等電位) lines. Explain why magnetic field reconnection cannot occur for $\vec{E} + \vec{u} \times \vec{B} = 0$. (15%)

4. Discuss the properties of MHD waves propagating along the magnetic field. (15%)

5. What is Virial theorem? (10%)

6. What is convective instability? (10%)

7. Is the Bow Shock a fast shock or a slow shock? When a satellite passes across the Bow Shock toward the magnetosphere, what kinds of magnetic field and plasma density profiles are expected? (10%)

8. Considering a uniform $\vec{B} = B\hat{z}$ and a constant electric field of $\vec{E} = E\hat{x}$. Draw a diagram showing the corresponding charged particle motion on the (x, y) plane. (Please give the reasoning.) (10%)