國立中央大學104學年度碩士班考試入學試題

所別：太空科學研究所碩士班 不分組(一般生)　科目：太空物理學　共 2 頁　第 1 頁
太空科學研究所碩士班 不分組(在職生)

本科考試禁用計算器　　＊請在答案卷（卡）內作答

Space Physics: Magnetosphere (50 points)

1.Please describe the drift motions in the system (a) with the plasma density or pressure gradient, and (b) with the time-independent magnetic field and electric field. (c) If a particle moves inward from the Earth's magnetotail and encounters the stronger magnetic fields during its drift motion, please discuss the energy changes of the particle based on adiabatic invariants. (25 points)

2.Please explain the frozen-in condition and its violation for the magnetic reconnection. (15 points)

3.Please linearize the following momentum equation step by step and explain your processes in detail. (10 points)

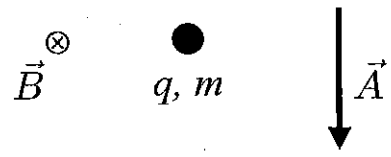
$$\frac{\partial}{\partial t}(\rho\vec{u}) + \nabla\cdot(\rho\vec{u}\vec{u}) = -\nabla P + \frac{1}{\mu_0}(\nabla\times\vec{B})\times\vec{B}$$

注意：背面有試題

Graduate School Entrance Exam: Space Physics (Ionosphere)
50 points total. Show all calculations.

Useful Hints:
Vector Triple Product: $\vec{A}\times(\vec{B}\times\vec{C}) = \vec{B}(\vec{A}\cdot\vec{C}) - \vec{C}(\vec{A}\cdot\vec{B})$

4. (25 points) Assume that a particle with electric charge q and mass m is in a magnetic field pointing into the page, as shown in the figure. The particle is also under the influence of a vector field $\vec{A}$, which points downwards. The particle is initially at rest.



   a) (9 points) Write the equation of motion for the particle if $\vec{A}$ is an electric field of value $\vec{E}$. Solve for the steady state velocity of the particle.

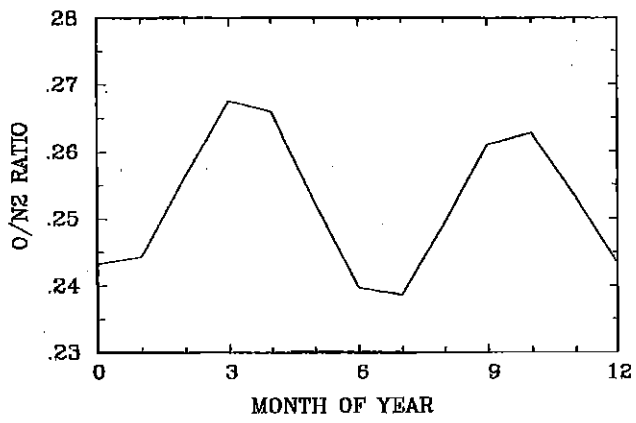
   b) (9 points) Consider the same situation, but let $\vec{A}$ be a gravitational acceleration $\vec{g}$. What is the equation of motion and steady state velocity of the particle?

   c) (7 points) Assume that instead of a single particle, we have a mixture of positive ions and negative electrons in the two systems described in Part a) and Part b). Will an electric current be created in both cases? Explain your answer.

5. (25 points) Answer the following questions:

   a) (10 points) Explain how the atmospheric pressure and density can be determined mathematically at different altitudes, if the temperature and composition of the atmosphere change with altitude. Assume the atmosphere is an ideal gas in hydrostatic equilibrium.

   b) (15 points) The following figure shows the ratio of atomic oxygen density (O) to molecular nitrogen density (N_2) in the thermosphere as a function of month. Based on this data, how would you expect the atmospheric drag on a satellite at fixed altitude to change through the year? Explain the physics behind your answer.



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