APPH 6101 Plasma Physics I
Homework 8: Due 17 November, 2005.

Questions 1-5

Due problems 6.9, 6.10, 6.11, 6.12, and 6.13 in Gurnett and Bhattacharjee, p. 247-248.

Question 6

Consider an inviscid (*i.e.* without viscosity) conducting plasma that is in a state of *steady* (but not necessarily uniform) rotation about the z-axis. Let the plasma conductivity be uniform in space, σ. Let the magnetic field be given as $\mathbf{B} = (B_z, \; B_r, \; 0)$, having no azimuthal component.

Part a

(Ignoring Hall terms in Ohm's Law), show that

$$\nabla \times \mathbf{J} = \sigma \nabla \times (\mathbf{V} \times \mathbf{B})$$

Part b

Explain why the plasma current is wholly azimuthal. Since $\nabla \cdot \mathbf{B} = 0$, show that the fluid has constant uniform angular velocity along any field line.