

Exercises for Space Plasma Physics:

VI. Magneto-statics

1. Under which conditions can a plasma described with magneto-hydrostatics (MHS)?
2. Which terms in MHD are neglected to derive the MHS-equations?
3. Give examples for solar system plasmas suitable for MHS models.
4. What is a force-free model? When can it be applied?
5. Can you give an example for a force-free plasmas?
6. Remember the main steps from a 2D-MHS-models to the Grad-Shafranov equation.
7. Now we extend the Grad-Shafranov theory to 2.5D, which means that all quantities are still invariant in the y-direction, but the magnetic field vector has three components. Use the ansatz

$$\vec{B} = \nabla A \times e_y + B_y e_y$$

and derive the corresponding Grad-Shafranov equation.

8. How does the Grad-Shafranov-equation (2.5D) look for a force-free plasma?