

Exercises for Space Plasma Physics:

I. Basic Plasma Physics concepts

1. What are the main criteria that an ionized gas qualifies for being a plasma?
2. What is the Debye length? How does the Debye-length change with density and temperature? Please try to give a physical explanation for this behavior.
3. Plasma-parameter: What are the main differences of plasmas with few and many particles in a Debye sphere? In which category are typical space plasmas?
4. Can a quasineutral plasma create large scale (larger than Debye length) electric currents? If no, why not? If yes, how?
5. Derive the induction equation from Maxwell equations (without displacement current) and Ohm's law for
 - (a) Spatial constant conductivity
 - (b) Spatial varying conductivity.
 - (c) Is a constant or a varying conductivity more likely in space plasmas?
6. Are electric or magnetic fields more important in space plasmas? Why?
7. Can magnetic reconnection happen in an ideal plasma?
8. Can one observe magnetic reconnection in numerical simulations of ideal plasmas? (Can the answer to this question be different from the previous answer?)