Examination „Fundamentals of plasma physics“ (12FFP)

As the first I usually ask for some simple derivation (e.g. Debye screening, dispersion relation for electron plasma waves or ion sound waves or electromagnetic waves, current filament, evolution of B field in MHD).

Then I ask some questions. Typical topics are listed below

1. What condition must fulfill an “ideal plasma”? Explain what it means “collective behavior”.
2. Coupling parameter, weakly and strongly coupled plasma, parameter of degeneracy.
3. Debye screening, potential of a screened charge
4. Coulomb collisions, collision frequency, Coulomb logarithm
5. Drifts in the one-particle approximation and the drifts of the fluids
6. Magnetic mirror principle, 1$^{st}$ adiabatic invariant, Coulomb logarithm, landau length
7. Ponderomotive force, derivation and physical significance
8. Transition from kinetic equations to two-fluid hydrodynamics, pressure tensor
9. Electron plasma waves, Landau damping, two-beam instability
10. Ion sound waves, plasma approximation
11. Propagation of electromagnetic waves without $B_0$, absorption mechanisms
12. Propagation of electromagnetic waves with $B_0$, cutoff and resonance, CMA diagram
13. System of equations of ideal and non-ideal MHD, magnetic Reynolds number
14. Hydromagnetic equilibrium, parameter $\beta$, instabilities caused by pressure gradient
15. Ambipolar diffusion, diffusion in weakly and strongly ionized plasmas, diffusion along and across magnetic field
16. Near-wall layers, Bohm criterion, collisionless shock wave
17. Types of radiation processes in plasmas and corresponding emission spectra, optical thickness
18. Conditions of thermodynamic equilibrium, local thermodynamic equilibrium (LTE)
19. Collisional processes in plasmas, principle of detailed balancing
20. Nuclear fusion, ideal ignition temperature, Lawson criterion
21. Systems with magnetic confinement, z-pinch and $\theta$-pinch
22. Kinetic description of plasmas, Vlasov equation, small parameters in the derivation of various collision integrals, Bogolyubov hypothesis, , Fokker-Planck collision term