

List of questions for the oral exam

Group 1

- 1) The DT fusion reaction, the sources of fuel for fusion, and the advantages of fusion
- 2) Power balance of a fusion reactor: conditions for energy production
- 3) Design of a fusion reactor: main elements, constraints and optimization process
- 4) Definition of plasma. Quasi-neutrality; Debye screening; plasma oscillations
- 5) Single particle motion in a constant magnetic field: gyro-motion and ExB drift
- 6) Single particle motion in a spatially varying magnetic field: the mirror effect
- 7) Time scales for relaxation processes (exchanges of energy and momentum)
- 8) Plasma resistivity and 'runaway' electrons
- 9) Fluid description of plasmas: discussion of the basic elements
- 10) Transition from multi-fluid to a single fluid description: the MHD model

Group 2

- 11) MHD equilibrium: choose and discuss a simple equilibrium configuration
- 12) Plasma stability: general discussion and an example of instability
- 13) The tokamak concept
- 14) MHD shear Alfvén waves: physical meaning and traces of the calculation
- 15) Cut-off points in the fluid model: physical meaning and examples
- 16) Resonances in the fluid model: physical meaning and examples (perpendicular propagation)
- 17) Waves in a fluid magnetized plasma, in perpendicular propagation: accessibility problem
- 18) Qualitative discussion of wave-particle interactions and resonant exchanges of energy
- 19) Ohmic heating and the need for additional (i.e. other than Ohmic) heating of fusion plasmas
- 20) Physical processes occurring when a neutral beam penetrates a plasma and criteria for designing a beam to heat fusion plasmas

Group 3

- 21) Heating using waves interacting with electrons
- 22) Heating using waves interacting with ions
- 23) Superconductors of Type I and II, Low and High-Temperature Superconductors, and normal conductors with zero electrical resistance
- 24) Main challenges for building fusion magnets using superconductors
- 25) Requirements and main issues associated with the fusion reactor first wall
- 26) Advantages of the magnetic divertor
- 27) Effects of neutrons on materials and the need for a neutron source to test fusion materials
- 28) Basic principles of inertial confinement fusion
- 29) Choose and discuss an important process characteristic of a burning plasma
- 30) Main issues associated with the use of Tritium in a fusion reactor