Statistical Physics

(PhD entrance exam topics)

1. The problem of random walk (The features of the distribution, the distribution for large step number, the central limit theorem)
2. Statistical description of particle systems (The notion of a microstate, density matrix formalism, the statistical ensemble, fundamental postulates and hypotheses, the number of microstates in macroscopic systems)
3. Statistical thermodynamics (Thermal and mechanical interaction of macroscopic bodies, the equilibrium conditions, the notions of work, heat and entropy)
4. The fundamental distributions of statistical mechanics (Microcanonical, canonical, and grand-canonical distributions and their relations to thermodynamics)
5. The monoatomic ideal gas (Gibbs paradox, the equipartition theorem)
6. Interacting systems (virial expansion of real gases, the van der Waals equation, Debey-Hückel theory of Coulomb systems)
7. Magnetism of independent particles (The Bohr-van-Leuwen theorem, Larmor diamagnetism, paramagnetism, adiabatic demagnetization)
8. Ferromagnetism (The Heisenberg model, the mean field approximation of Weiss, the Ising model and its solution in one dimension)
9. Statistical description of ideal quantum gases (Fermi-Dirac and Bose-Einstein statistics, high temperature approximations)
10. Nonequilibrium statistical physics (the master equation, the linear response theory, stochastic systems).

Suggested readings:

L.D. Landau, E.M. Lifshitz: Statistical Physics, Third Edition, Part 1: (Course of Theoretical Physics, Volume 5) Elsevier 2005