

Homework problems

1. Derive the partition function of free scalar field given by the formula (19) from Lecture II directly from the path-integral representation given by Eq. (16) from Lecture XI.

The tip how to solve the problem

Perform the Gaussian functional integration, using the Fourier transformed field in momentum space which obeys the periodic boundary condition. At an intermediate step there should appear a log of thermal propagator. The sum over Matsubara frequencies can be taken using the formulas (26, 31) from Lecture XV.

2. Derive the approximations (25) from Lecture IX.
3. Derive the formulas (60, 61, 62) from Lecture XII, using the method of dimensional regularization.
4. Derive the effective potential (88) from Lecture XIV, starting with the formula (90) from the same lecture.
5. Derive the effective potential (88) from Lecture XIV, starting with the formula (92) from the same lecture.