

Question bank for the Stat Mech for Mat exam

1. Microstates, macrostates, thermodynamic averages and the density of states	1 1
2. Equiprobability and the Boltzmann definition of entropy	1 2
3. Statistical mechanics of adatoms on a surface. Non-additive entropy at the nanoscale	1 3
4. The canonical partition function from a system-bath description	1 4
5. Statistical mechanics of a paramagnetic material	1 5
6. Information entropy and the Gibbs definition of entropy	1 6
7. The definition of ensembles using constrained maximization of entropy	2 1
8. The link between statistical mechanics and thermodynamic potentials	2 2
9. The grand canonical ensemble. Sketch of the derivation and meaning	2 3
10. Density fluctuations and the ideal gas law	2 4
11. Langmuir adsorption isotherm from a statistical mechanical perspective	2 5
12. Non-interacting systems. Partition function and thermodynamic properties	2 6
13. Indistinguishable particles: definition of microstates and symmetry of the wavefunction	3 1
14. Bose and/or Fermi statistics from a grand-canonical formalism	3 2
15. Vibrations in solids: classical and quantum statistics	3 3
16. Heat capacity in solids and low-dimensional materials	3 4
17. A density-functional theory of the free electron gas (NO Sommerfeld expansion)	3 5
18. The Ising model in 1D, exact treatment.	3 6
19. The Ising model in 2D, mean field treatment.	4 1
20. Response properties of the mean-field Ising model	4 2
21. Universality. Mapping on the Ising model, critical exponents	4 3
22. Statistical mechanical description of liquids. The pair correlation functions	4 4
23. The reversible work theorem	4 5
24. Pair potentials and the properties of liquids	4 6
25. Statistical description of polymer chains	5 1
26. Entropy-driven elasticity of a freely-joint polymer	5 2

Rules:

- The exam contributes 60% to the final mark, 40% coming from the evaluation of lab report that have already been graded during the year
- The question bank is made available to all students at the end of the course
- The candidate throws two dice to select a question. They have the right to throw again once, but cannot return on the first question if they dislike the second one even more.