

Exercise #0

due date: October 09 2022

1. An urn contains 4 numbered tokens from 1 to 4. After two extractions, consider the composite event consisting in extracting first the token 2 and then the token 4. Compute the conditional probability $P(4|2)$ in the following cases: a) If the first token is not put back into the urn after being extracted; b) If the first token is put back in the urn after being extracted
2. Given N extraction of a random number x_i define its average value. Is this value itself a random number? Can you estimate its fluctuations?
3. What is the binomial distribution and what are the relevant parameters describing it?
4. What is the difference between isothermal and adiabatic transformation.
5. A damped harmonic oscillator of mass m and oscillator characteristic frequency ω initially departs with initial velocity v_0 from the equilibrium position. After some time we found it at rest. What is the work done by the damping force on the system?
6. Consider a transformation in a perfect classical gas.
By doubling the pressure we get an halving of the volume. What is the transformation?
Do the same kind of transformation behave the same for a quantum Fermi gas?
7. N independent two level systems are thermalized at a given temperature T . What is the ratio between the average number of systems in the higher energy level and that on the lower?
8. What is the Maxwell-Boltzmann distribution?
9. What are the Bose-Einstein and Fermi-Dirac distributions.
10. What is the equipartition principle and when it holds?