Exercises: Mathematical Statistical Physics

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Sheet 1

Exercise 1: (Boyle-Mariotte) Explain the law of Boyle-Mariotte, i.e. pV is constant at fixed temperature, from the microscopic motion of particles in a box.

Exercise 2: (Entropy of a gas) Given a gas at temperature T with entropy S. Assume you increase the temperature by heating the system, i.e. adding the energy dQ. Calculate the growth in entropy, i.e. show that dS is proportional to $\frac{dQ}{T}$.

Exercise 3: (Osmosis) Two cylinders containing water are connected by a tube. The tube can be closed or opened using a valve. Assume that the valve is closed an one puts salt into one of the cylinders. Further assume that the water-level of both cylinders is equal.

What happens when you open the valve? Discuss qualitatively taking close attention to the entropy and the different forms of energy of the system.