Exercise 02

NAME:	MATRICULATION NUMBER:
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The exercise is due on Wednesday, May 02, 8 am.

2.1 Text book

Read section 1.4 in G.H. Findenegg, T. Hellweg „Statistische Thermodynamik".

2.2 Coin Toss

Calculate the probability for a coin toss experiment (heads or tails) to

(a) achieve exactly two, three or four times "tail".

(b) achieve exactly 40 times "tail" out of 100 tosses.

(c) achieve between 45 to 55 times "tail" out of 100 tosses.

2.3 Lottery

You are playing lottery. How is your chance in a game 6 out of 49 to achieve

(a) 6 correct numbers without super number?

(b) 5 correct numbers and the correct super number?

(c) 3 correct numbers?

2.4 Lighter production

The reject rate (defect product) in a lighter production facility is $p = 0.01$. How big is the probability that within 100 lighter:

(a) no lighter is defect?

(b) one lighter is defect?

(c) two lighters are defect?

2.5 Dice game

How big the probability of getting exactly two time 6 pips and three times 2 pips rolling 5 dice?
Hint: Use the multinomial distribution.

2.6 Random walk

After a long night at the local pub two totally drunk friends are on their way home. To overcome the boredom of this walk they are starting a "random walk" from a lamp pole. In this "random walk" both of them are either doing a step to the left or a step to the right (with the same probability). How big is the probability that after N steps they met each other again. (Consider a equal step length and equally timed steps.)

2.7   1D Harmonic Oscillator

The energy eigenvalues of the harmonic oscillator are

$$E_n = \left(n + \frac{1}{2}\right)\hbar\omega \qquad n = 0, 1, 2, \cdots$$

Let the thermal energy $k_b T$ be much smaller than $\hbar\omega$:

(a) How big is the fraction of the probabilities of the oscillator in the ground state and the first excited state?

(b) Calculate the average energy (as a function of T), if only those two states are occupied.