

Exercise 01

NAME:	MATRICULATION NUMBER:
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RESULTS:

1.1	OF 4P
1.2	OF 14P
1.3	OF 1P
1.4	OF 4P
TOTAL	OF 23P

GENERAL INSTRUCTIONS

- SUBMIT YOUR SOLUTION TO OLIVER LEMKE (R. 35.17) BEFORE **THURSDAY 11. MAY AT 8.15 AM.**
- FILL OUT THIS COVER SHEET AND SUBMIT IS ALONG WITH YOUR SOLUTION.
- SHOW HOW YOU ARRIVED AT YOUR ANSWER.

1.1 Car tyre (4P)

- (a) Calculate the number of molecules per 1 cm^3 in car tyre with an absolute pressure of 3.7 bar at room temperatur ($T = +25^\circ\text{C}$). Assume that the tyre is filled with an ideal gas.
- (b) What is the number of molecules per 1 cm^3 in the same tyre in a cold winter night at $T = -20^\circ\text{C}$?
- (c) What is the pressure in the tyre in a cold winter night at $T = -20^\circ\text{C}$?
- (d) After driving for some time, the tyre is heated to $T = +45^\circ\text{C}$. What is the pressure in the tyre now?

Hint: you can assume that the thermal expansion coefficient of rubber is zero.

1.2 Two dice (14 P)

Consider the following random experiment: two dice are thrown and the total number of pips are counted.

- (a) What is the sample space Ω , the set of events X and the event probability p_X of this random experiment?
- (b) Plot a histogram of p_X .
- (c) Calculate the mean, the variance, and the standard deviation for this probability distribution.
- (d) Take two dice and carry out the experiment 30 times. Record the outcome and the total number of pips in each round.
- (e) Calculate the probability of the sequence of outcomes and the probability of the sequence of events for your particular series of experiments.
- (f) Calculate the mean, the variance, and the standard deviation from your. list of total number of pips.
- (g) Construct a histogram from the list of total number of pips. Plot the histogram. (You can plot it into the same graphs (b).)
- (h) Compare your experimental result with the expected result. Are there deviations? Why? Are the deviations higher or lower than expected?

1.3 Birthdays**(1 P)**

Ignoring leap years, calculate the probability that, among 25 randomly chosen people, at least two have the same birthday.

Hint: Consider the probability that everyone has a unique birthday.

1.4 Boys or girls?**(4 P)**

Assuming that the inherent ratio of male to female children is unity, determine the following probabilities for a family of six children.

- (a) The four oldest children will be boys and the two youngest will be girls.
- (b) Exactly half the children will be boys.
- (c) All six children will be of the same sex.
- (d) A second girl is born last.