## *Exercise 1: Why teacher should never calculate an average from grades?*

The tests were given to students and each of the tests was evaluated by points from 0 to 100. Here are the results of five students (named A to E):

A 99, 89, 89, 79, 69, 59
B 91, 81, 71, 61, 51, 51
C 99, 99, 89, 79, 69, 59
D 99, 98, 89, 88, 87, 60, 59, 58, 39
E 99, 91, 89, 75, 74, 60, 59, 40, 39, 0, 0, 0, 0

Students A, B, C were graded equidistantly (1 ≥ 90, 2 <89; 80>, 3 <79; 70>, 4 <69; 60>, 5 <59; 0>). Students D and E were graded progressively (1 ≥ 90, 2 <89; 75>, 3 <74; 60>, 4 <59; 40>, 5 <39; 0>).

a) Calculate the average score for each student and grade him accordingly.
b) Grade each test separately. To obtain a final grade, average the individual grades from tests.

Compare the grades obtained by the approaches a) and b). In case of different results, which grade is the correct one? What is a cause of possible errors?

## *Exercise 2: Weighing scales*

What is the possible relative error for weighting 1, 2, 6, 8, 16, and 24 mg on balances with an absolute precision of ± a) 0.1 a b) 0.01 mg?

## *Exercise 3: Pipette*

Suppose you purchase a 10 ml class A pipette.

a) Represent a probable delivered volume with its uncertainty based on the guaranteed tolerance. A pipette's uncertainty is the range of volumes in which its true volume is expected to lie.

You have made a calibration of the pipette by 10 times weighting the amount of water in the pipette, with the following results: 10.002, 9.993, 9.984, 9.996, 9.989, 9.983, 9.991, 9.990, 9.988, and 9.999.

The precision is characterized by standard deviation (whatever it is - we will discuss it in details later; in Excel: SMODCH.VÝBĚR, STDEV).

b) What is a probable delivered volume and its uncertainty based on your calibration?
c) What was the guaranteed uncertainty?
d) What was the systematic error?
e) What is the precision after calibration?