Name:	Date:
Class:	

Supplementary Examination for the
Standardised Competence-Oriented
Written School-Leaving Examination

AHS

October 2018

Mathematics

Supplementary Examination 1
Candidate's Version

Bundesministerium
Bildung, Wissenschaft
und Forschung

Instructions for the supplementary examination

Dear candidate,

The following supplementary examination is comprised of five tasks that can be completed independently of one another.

Each task contains two parts: The statement of the task requires you to demonstrate core competencies, and the guiding question that follows it requires you to demonstrate your ability to communicate your ideas.

You will be given preparation time of at least 30 minutes, and the examination will last at the most 25 minutes.

Assessment

Each task can be awarded zero, one or two points. There is one point available for each demonstration of core competencies as well as for each guiding question. A maximum of 10 points can be achieved.

For the grading of the examination the following scale will be used:

Grade	Minimum number of points
Pass	4 points for the core competencies + 0 points for the guiding questions 3 points for the core competencies + 1 point for the guiding questions
Satisfactory	5 points for the core competencies + 0 points for the guiding questions 4 points for the core competencies + 1 point for the guiding questions 3 points for the core competencies + 2 points for the guiding questions
Good	5 points for the core competencies + 1 point for the guiding questions 4 points for the core competencies + 2 points for the guiding questions 3 points for the core competencies + 3 points for the guiding questions
Very good	5 points for the core competencies + 2 points for the guiding questions 4 points for the core competencies + 3 points for the guiding questions

The examination board will decide on the final grade based on your performance in the supplementary examination as well as the result of the written examination.

Good Luck!

Task 1

Price

The net price of a product is N euros. The gross price is the sum of the net price and m % Value Added Tax (calculated using the net price).
The sale price V is obtained by subtracting a discount of r % of the gross price from the gross price.

Task:

Write down a formula for the sale price V in terms of N, m and r.

V = ____

Guiding question:

Write down whether the same sale price V would be obtained if a discount of r % of the net price were subtracted from the net price first, before m % of the resulting price were added on to this result. Justify your decision.

Furthermore, write down the size of the discount that would have to be applied to a product that has 20 % Value Added Tax so that the net price were equal to the sale price.

Task 2

Iodine-131

The isotope iodine-131 is radioactive.
After t days, the remaining amount $N(t)$ of iodine-131 decreases approximately exponentially. The amount of iodine-131 at time $t = 0$ is given by N_0.

Task:

After four days, 30 % of the original amount of iodine-131 has decayed. Determine the percentage of the amount of iodine-131 that decays per day and explain your method.

Guiding question:

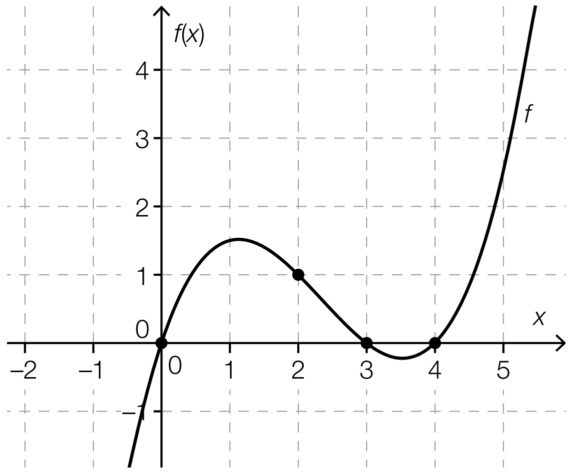
Determine the general (without using concrete values) relative change of an exponential function of the form $N(t) = N_0 \cdot a^t$ in the time periods $[0, t_1]$ and $[t_0, t_0 + t_1]$ (where $t_0, t_1 \in \mathbb{R}^+$).

Interpret the results (drawing on a characteristic property of exponential functions).

Task 3

Function and the Antiderivative

The diagram below shows a section of the graph of a third degree polynomial function, *f*. The points shown in bold have integer coordinates.



Task:

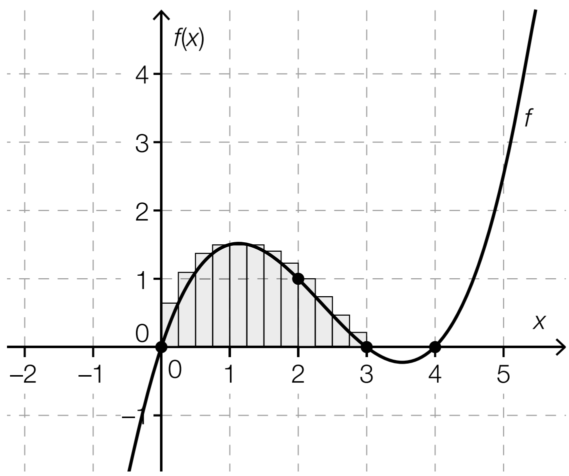
Write down the number and positions of any maxima, minima and points of inflexion of an antiderivative, *F*, of *f*.

Guiding question:

The graph of the function *f* encloses two finite areas bounded by the *x*-axis.

Write down two formulae, one using *f* and one using *F*, that could be used to calculate the total area of these finite areas.

In the diagram shown, the larger area has been divided into 12 rectangles of equal width. The sum of these rectangular areas (the upper sum) can be used to approximate the value of the area of the larger area.
Write down the value of the upper sum and determine by how much this value differs from the actual area of this region by using an adequate model function *f*.



Task 4

Vertical Throw

The height of a body thrown at time $t = 0$ can be described by a function h where $h(t) = 50 + 60 \cdot t - 5 \cdot t^2$ ($h(t)$ in metres, t in seconds).

Task:

Determine the equation of the first derivative of h and write down the meaning of this function in the context of the movement of the body using the correct units.

Determine the maximum $E = (t_1, h(t_1))$ of the function h and interpret the meaning of both coordinates, t_1 and $h(t_1)$, in the given context.

Guiding question:

Determine the average rate of change of the function h in the time period $[0, t_1]$ and interpret the result in the context of the movement of the body.

The Mean Value Theorem of differentiation says that for a function f, under certain conditions, in an interval $[a, b]$ there exists at least one point $x_0 \in (a, b)$ such that $f'(x_0) = \frac{f(b) - f(a)}{b - a}$ holds.

Interpret this statement for the function h in the given context for the time period $[0, t_1]$.

Determine the point t_0 as described in the Mean Value Theorem for the function h in the time period $[0, t_1]$.

Task 5

Statistical Values

An ordered list of data with values $a_1, a_2, \dots, a_n$ ($n \in \mathbb{N}$, $n > 3$) is given.

Task:

For each of the statements given below, write down if it is true or false and in each case justify your decision.

Statement 1: The median is definitely a value that appears in the ordered list of data.

Statement 2: For the median m of the list of data, the formula $m = \frac{a_1 + a_n}{2}$ holds.

Statement 3: For the mean $\bar{x}$ of the list of data, the formula $n \cdot \bar{x} = a_1 + a_2 + \dots + a_n$ holds.

Guiding question:

Write down an ordered list of data that contains 11 values and satisfies the following conditions:
The mean, the median and the range have the value 10.
Explain your reasoning.

Explain how you could add two values to your list of data such that neither the median nor the mean change, but the range increases by 6.