Name:	Date:
Class:	

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

AHS

June 2018

Mathematics

Supplementary Examination 6
Candidate's Version

BMBWF
BUNDESMINISTERIUM
FÜR 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

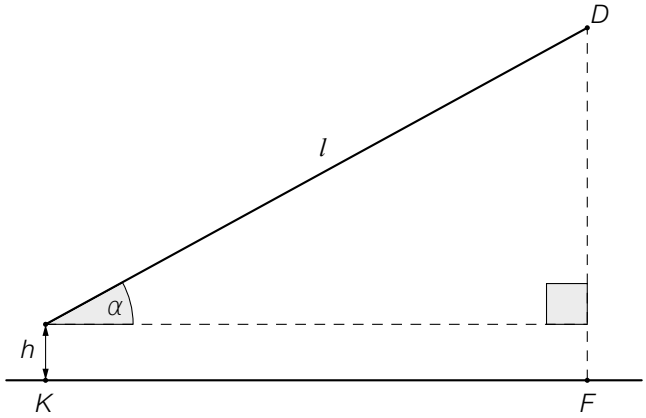
The examination board will decide on the final grade based on your performance in the supplementary examination as well as the result of the written examination.

Good Luck!

Task 1

Flying a Kite

A child is flying a kite. An approximation of the positions of the child (K) and the kite (D) at a particular time is shown in the diagram below.



The position of the child, K, as well as the point F lie in a horizontal plane. The child is holding the kite at a height h of 1.5 metres above the ground. The length of the taut string is l = 50 m.

Task:

Write down a formula that can be used to calculate the height $\overline{FD}$ of the kite above the horizontal plane (in metres) in terms of the angle α.

Guiding question:

Write down a function to calculate the size of the angle α for which the horizontal distance $\overline{KF}$ is equal to the height $\overline{FD}$ of the kite and determine the size of α.

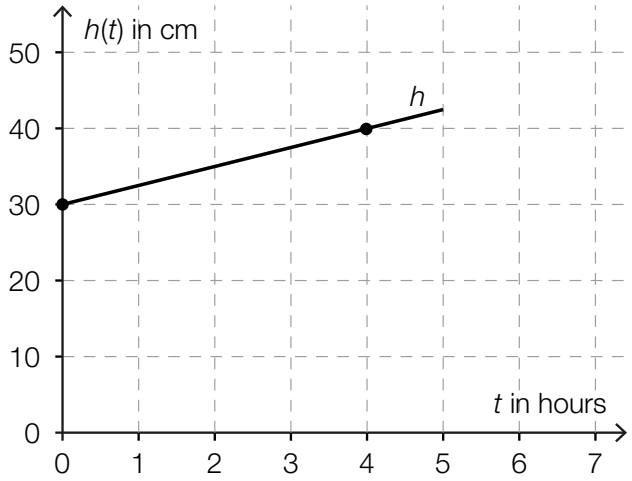
Task 2

Snowfall

The height of the snow level during a five-hour snowfall can be modelled by a linear function, h. The height of the snow, $h(t)$, is measured in cm and the time, t, is measured in hours where $0 \leq t \leq 5$.

Task:

The graph shown below shows the height of the snow level during this five-hour snowfall. The points shown in bold have integer coordinates.



Write down the equation of the function that gives the height of the snow level, h, in terms of the time t and write down the meaning of the numbers that appear in the equation.

Guiding question:

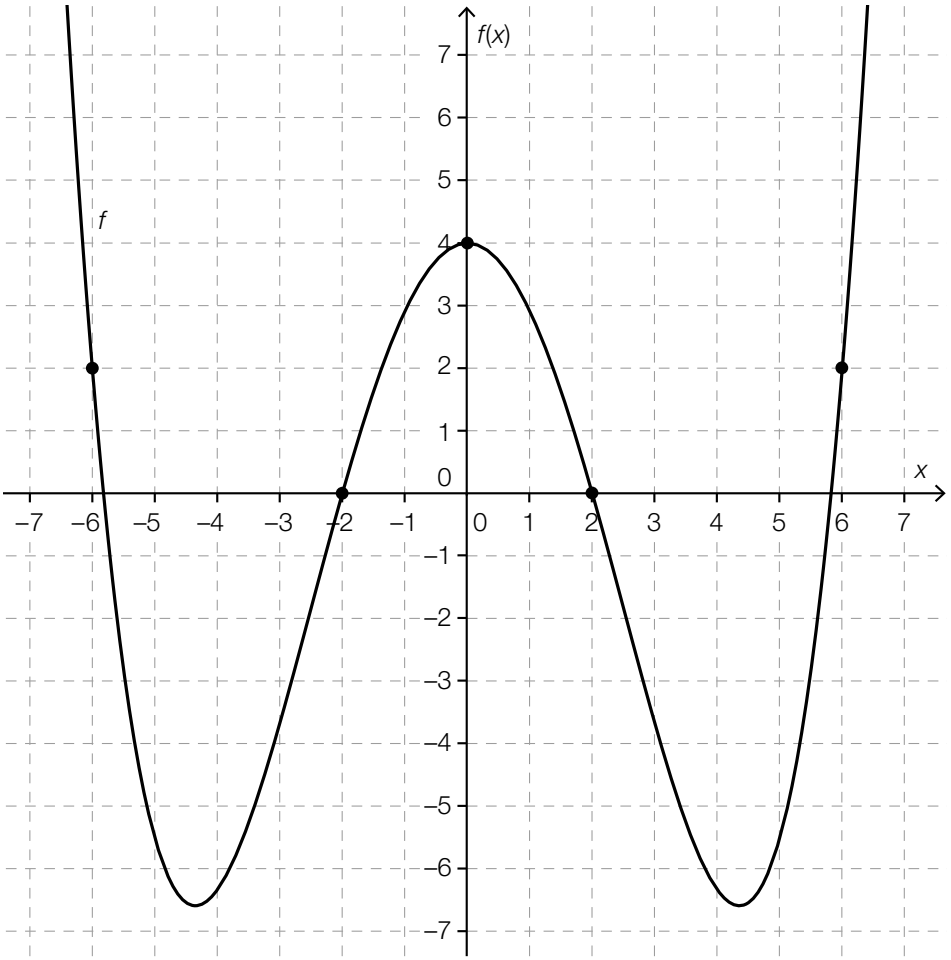
For a function h_1, write down all of the conditions that must be fulfilled so that h_1 describes a directly proportional relationship between the height of the snow level, $h_1(t)$ (in cm), and the time t (in hours).

Write down the equation of the directly proportional function h_1 if the snow level is 20 cm high after a five-hour snowfall.

Task 3

Fourth Degree Polynomial Function

The diagram below shows the graph of a fourth degree polynomial function, f, with equation $f(x) = a \cdot x^4 + b \cdot x^2 + c$ where $a, b, c \in \mathbb{R}$. The points shown in bold have integer coordinates.



Task:

Determine the parameters a, b and c of the function f.
Write down the intervals for which $f'(x) > 0$ holds and explain your method.

Guiding question:

Write down a value of $k \in \mathbb{R}$ where $k > 2$ such that the equation shown below is generally valid and explain your reasoning.

$$\int_{-3}^{0} f(x)\,dx - \int_{0}^{k} f(x)\,dx = f'(0)$$

There is a further value $h \in \mathbb{R}$, $0 \leq h \leq 2$ for which the equation $\int_{-3}^{0} f(x)\,dx - \int_{0}^{h} f(x)\,dx = f'(0)$ is satisfied. Determine this value.

Task 4

Number of Inhabitants

The number of inhabitants in a particular country in year t is represented by $B(t)$.

Task:

Interpret both of the equations below with respect to the number of inhabitants in this country.

- $\frac{B(2015)}{B(1950)} = 2$
- $\frac{B(2015) - B(2000)}{B(2000)} = 0.1$

Guiding question:

Interpret the equation $\frac{B(2015) - B(2000)}{15} = 100\,000$ in the given context.

Using the equations given, determine the number of inhabitants in this country in the year 2015 and explain your reasoning.

Task 5

Discount Dice

A shop has a game that customers can play to win discounts. The aim of the game is to roll the highest possible number with a (fair) dice. (A dice is considered to be “fair” if the probability of the dice showing any of its faces after being thrown is equal for all six faces.)
If a person rolls a number from 1 to 5, they win a percentage discount equal to the number shown.
If a person rolls a six on their first roll, they are allowed to roll again. The sum of the numbers from both rolls corresponds to the percentage discount the customer receives.

Task:

Determine the probability, P, that a customer gets a 10 % discount.
Explain your reasoning.

Guiding question:

The random variable X describes the percentage discount that a customer can receive.

Write down all of the possible values of the random variable X and their corresponding probabilities.

Determine the expectation value $E(X)$ of the random variable X and explain the meaning of the value obtained in the given context.