Name:	
Class:	

Standardised Competence-Oriented
Written School-Leaving Examination

AHS

8th May 2019

Mathematics

Part 1 and Part 2 Tasks

Bundesministerium
Bildung, Wissenschaft
und Forschung

Advice for Completing the Tasks

Dear candidate!

The following booklet contains Part 1 tasks and Part 2 tasks (divided into sub-tasks). The tasks can be completed independently of one another. You have a total of *270 minutes* available in which to work through this booklet.

Please do all of your working out solely in this booklet and the paper provided to you. Write your name and that of your class on the cover page of the booklet in the spaces provided. Also, write your name and consecutive page numbers on each sheet of paper used. When answering each sub-task, indicate its name/number on your sheet.

In the assessment of your work, everything that is not crossed out will be considered. Your solutions must be marked clearly. If a solution is not clearly marked or if more than one solution is given, the task will be considered to be unsolved.

You may use the official formula booklet for this examination session as well as approved electronic device(s), provided there is no possibility to communicate via internet, Bluetooth, mobile networks, etc. and there is no access to your own data stored on the device.

An explanation of the task types is available in the examination room and can be viewed on request.

Please hand in the task booklet and all used sheets at the end of the examination.

Changing an answer for a task that requires a cross:

1. Fill in the box that contains the cross.
2. Put a cross in the box next to your new answer.

In this instance, the answer “5 + 5 = 9” was originally chosen. The answer was later changed to be “2 + 2 = 4”.

1 + 1 = 3	☐
2 + 2 = 4	☒
3 + 3 = 5	☐
4 + 4 = 4	☐
5 + 5 = 9	■

Selecting an item that has been filled in:

1. Fill in the box that contains the cross for the answer you do not wish to give.
2. Put a circle around the filled-in box you would like to select.

In this instance, the answer “2 + 2 = 4” was filled in and then selected again.

1 + 1 = 3	☐
2 + 2 = 4	■
3 + 3 = 5	☐
4 + 4 = 4	■
5 + 5 = 9	☐

Assessment

The tasks in Part 1 will be awarded either 0 points or 1 point or 0, ½ or 1 point, respectively. The points that can be reached in each task are listed in the booklet for all Part 1 tasks. Every sub-task in Part 2 will be awarded 0, 1 or 2 points. The tasks marked with an $\boxed{\text{A}}$ will be awarded either 0 points or 1 point.

Two assessment options

1) If you have reached **at least 16** of the 28 points (24 Part 1 points + 4 $\boxed{\text{A}}$ points from Part 2), a grade will be awarded as follows:

Pass	16–23.5 points
Satisfactory	24–32.5 points
Good	33–40.5 points
Very Good	41–48 points

2) If you have reached **fewer than 16** of the 28 points (24 Part 1 points + 4 $\boxed{\text{A}}$ points from Part 2), but have reached a **total of 24 points or more** (from Part 1 and Part 2 tasks), then a “Pass” or “Satisfactory” grade is possible as follows:

Pass	24–28.5 points
Satisfactory	29–35.5 points

From 36 points upward, the assessment key specified in 1) applies.

If you have reached fewer than 16 points in Part 1 (including the compensation tasks marked with an $\boxed{\text{A}}$ from Part 2) and if the total is less than 24 points, you will not pass the examination.

Good luck!

Task 1

Basic Operations

For two integers a, b where $a < 0$ and $b < 0$, holds: $b = 2 \cdot a$.

Task:

Which of the following calculations always result in a natural number?
Put a cross next to each of the two correct calculations.

$a + b$	☐
$b : a$	☐
$a : b$	☐
$a \cdot b$	☐
$b - a$	☐

[0/1 point]

Task 2

Stopping Distance

Student drivers learn in a driving school that the stopping distance *s* can be approximated by the following formula. In the formula, *v* is the speed of the vehicle (*s* in m, *v* in km/h).

$$s = \frac{v}{10} \cdot 3 + \left(\frac{v}{10}\right)^2$$

When driving “at sight”, the driver has to choose the speed of the vehicle in such a way that stopping within the viewable distance is possible at any moment. Viewable distance means the length of the road visible for the driver.

Task:

Determine the maximum permissible speed when the viewable distance is 25 m.

The maximum permissible speed is ≈ ______________ km/h.

[0/1 point]

Task 3

Solving Inequalities

Below, you will find two linear inequalities.

I: $7 \cdot x + 67 > -17$
II: $-25 - 4 \cdot x > 7$

Task:

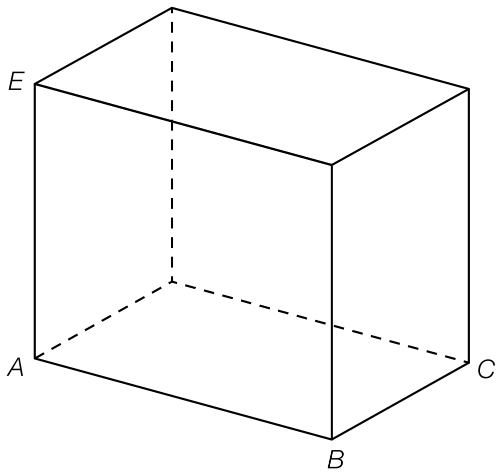
Find all real numbers x that solve both inequalities.
Write down the set of these numbers as an interval.

[0/1 point]

Task 4

Vertices of a Cuboid

The diagram below shows a cuboid. Its vertices A, B, C and E are shown in the diagram.



Task:

For the other vertices of the cuboid, R, S and T, the following relationships hold:

$R = E + \overrightarrow{AB}$

$S = A + \overrightarrow{AE} + \overrightarrow{BC}$

$T = E + \overrightarrow{BC} - \overrightarrow{AE}$

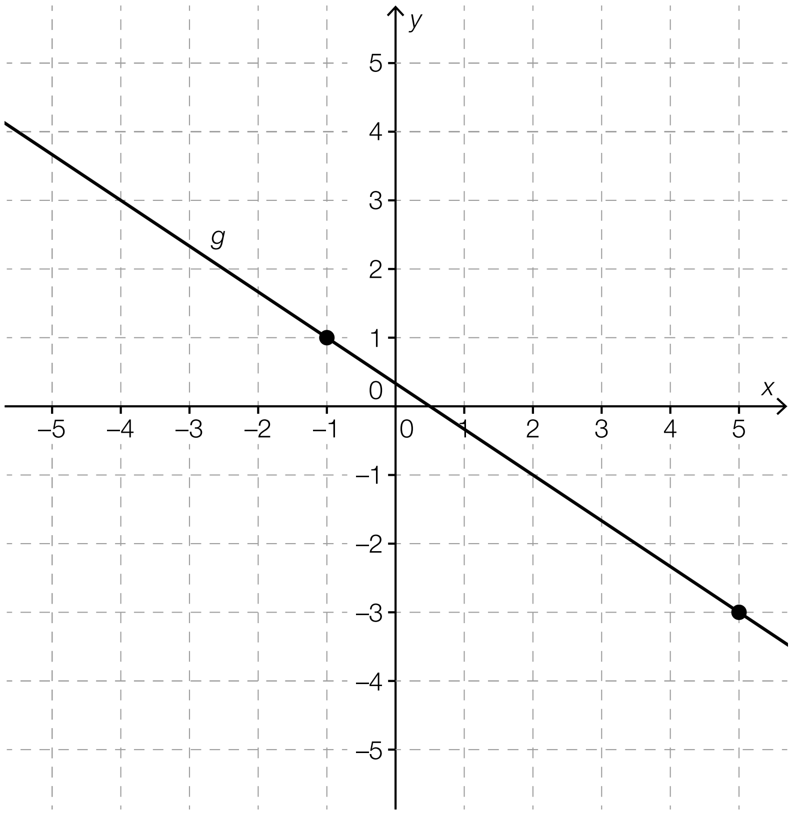
In the diagram above, label the vertices R, S and T in a clearly visible way.

[0/1 point]

Task 5

Vector Equation of a Line

The diagram below shows the line g. The points marked on the line g have integer coordinates.



Task:

Complete the following vector equation of the line g by writing down the values of a and b with $a, b \in \mathbb{R}$.

$g\colon X = \begin{pmatrix} a \\ 3 \end{pmatrix} + t \cdot \begin{pmatrix} 3 \\ b \end{pmatrix}$ where $t \in \mathbb{R}$

a = ______________________________

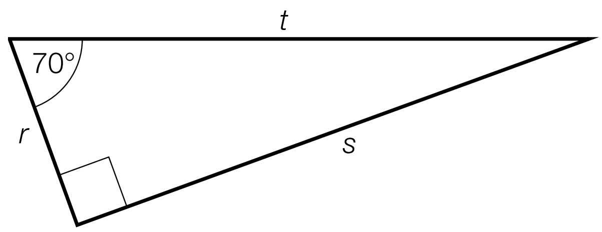
b = ______________________________

[0/1 point]

Task 6

Triangle

The following triangle with sides *r*, *s* and *t* is given.



Task:

Determine the ratio $\frac{r}{t}$ for this triangle.

[0/1 point]

Task 7

Matching Functions

The formula $F = \frac{a^2 \cdot b}{c^n} + d$, where $a, b, c, d \in \mathbb{R}$, $n \in \mathbb{N}$ and $c \neq 0$, $n \neq 0$, is given.

Assuming that only one of the quantities a, b, c, d or n is variable and all others are constant, F can be written as a function dependent of the respective variable.

Task:

Which of the relationships below describe a linear function (where domain and range are suitable)?
Put a cross next to both correct relationships.

$a \mapsto \frac{a^2 \cdot b}{c^n} + d$	☐
$b \mapsto \frac{a^2 \cdot b}{c^n} + d$	☐
$c \mapsto \frac{a^2 \cdot b}{c^n} + d$	☐
$d \mapsto \frac{a^2 \cdot b}{c^n} + d$	☐
$n \mapsto \frac{a^2 \cdot b}{c^n} + d$	☐

[0/1 point]

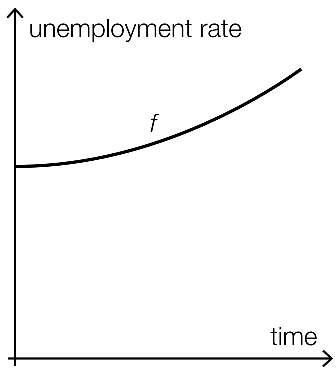
Task 8

Unemployment Rate

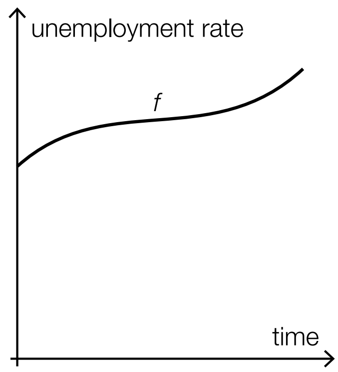
A politician, who wants to highlight the successful employment policies of one of the governing parties, says, “The growth of the unemployment rate has decreased throughout the year.”
An opposition politician replies, “The unemployment rate has increased throughout the year.”

Task:

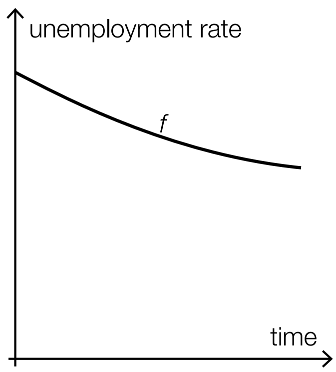
The development of the unemployment rate throughout the year can be modelled by a function *f* in terms of the time.
Which of the following graphs shows the development of the unemployment rate throughout the year assuming that the statements of both politicians hold true?
Put a cross next to the correct graph.



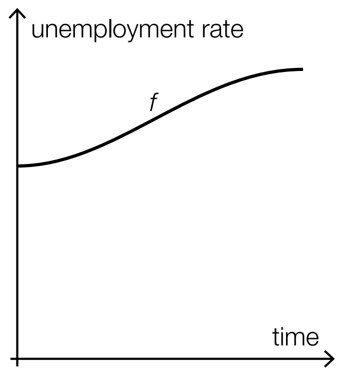
☐



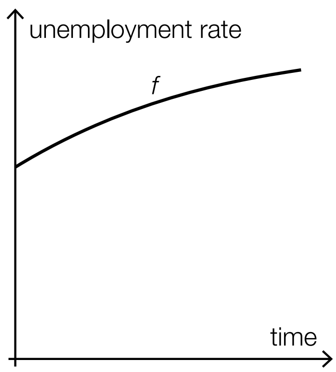
☐



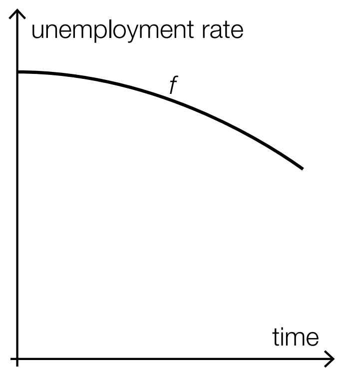
☐



☐



☐



☐

[0/1 point]

Task 9

Water Container

The liquid in a cuboid water container stands at the height of 40 cm. The liquid fully drains 8 minutes from the opening of the drain.

A linear function h with equation $h(t) = k \cdot t + d$, where $t \in [0, 8]$, can be used to describe the height of the liquid in the container (in cm) t minutes from the opening of the drain.

Task:

Write down the values of k and d.

k = ____

d = ____

[0/1 point]

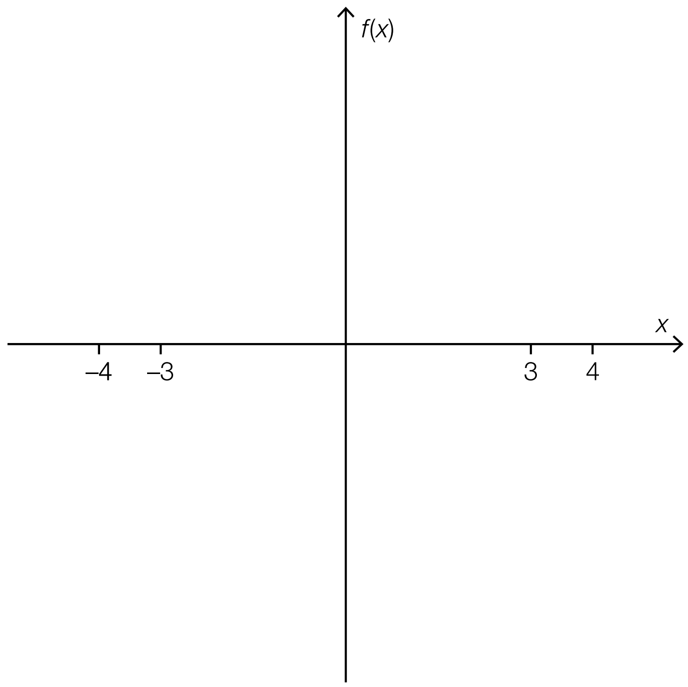
Task 10

Shape of a Fourth Degree Polynomial Function

There are fourth degree polynomial functions that have exactly three zeros at x_1, x_2 and x_3, where $x_1, x_2, x_3 \in \mathbb{R}$ and $x_1 < x_2 < x_3$.

Task:

In the interval [–4, 4] in the coordinate system below, sketch the shape of such a function *f* that has all three zeros in the interval [–3, 3].



[0/1 point]

Task 11

Active Ingredient

The decrease in the active ingredient of a medication in the bloodstream can be modelled by an exponential function.
After one hour, 10 % of the initial amount has been broken down.

Task:

Determine the percentage of the original amount of the ingredient that remains in the bloodstream after a total of four hours.

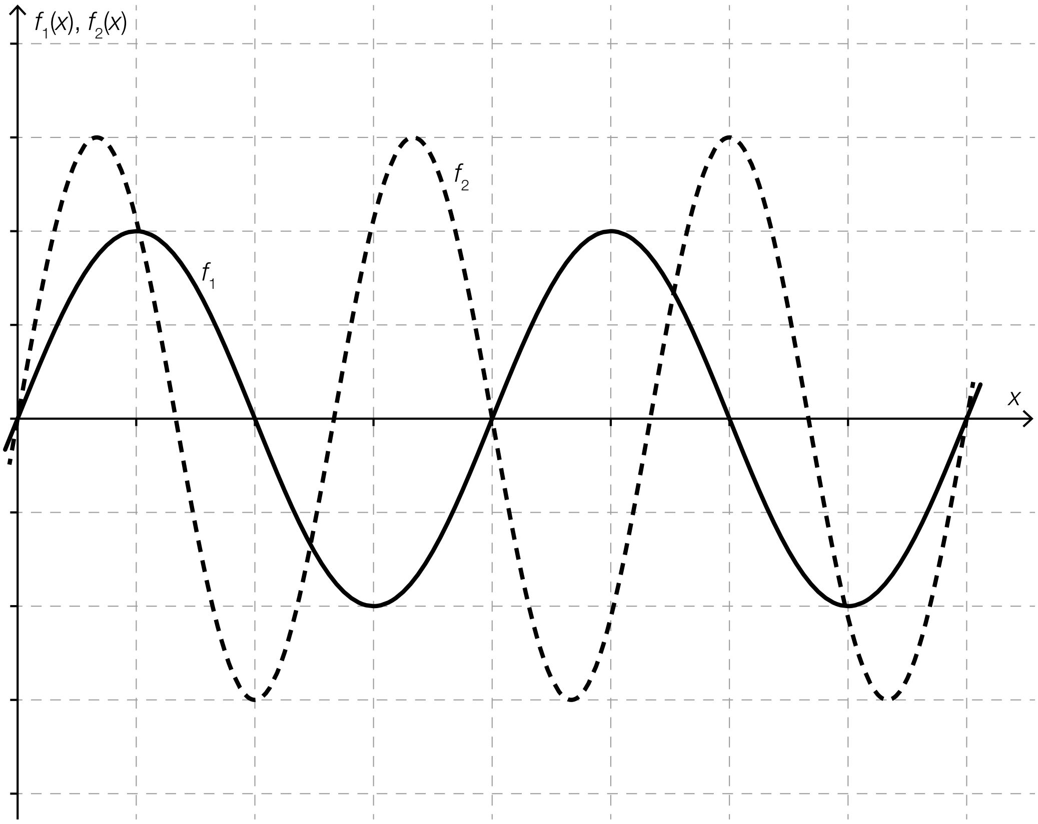
____________ % of the initial amount

[0/1 point]

Task 12

Graphs of Two Trigonometric Functions

The following diagram shows the graphs of the functions $f_1: \mathbb{R} \to \mathbb{R}$ and $f_2: \mathbb{R} \to \mathbb{R}$ with equations $f_1(x) = a_1 \cdot \sin(b_1 \cdot x)$ and $f_2(x) = a_2 \cdot \sin(b_2 \cdot x)$ where $a_1, a_2, b_1, b_2 > 0$.



Task:

Complete the following sentence by putting a cross next to one of the given possibilities for each gap so that the sentence becomes a correct statement.

For the values of the parameters, ___①___ and ___②___ hold.

①	
$a_2 < a_1$	☐
$a_1 \leq a_2 \leq 2 \cdot a_1$	☐
$a_2 > 2 \cdot a_1$	☐

②	
$b_2 < b_1$	☐
$b_1 \leq b_2 \leq 2 \cdot b_1$	☐
$b_2 > 2 \cdot b_1$	☐

[0/½/1 point]

Task 13

Crime Statistics 2010–2011

The following table describes how many criminal cases were reported in the years 2010 and 2011 in each Austrian province.

Province	Reported crimes 2010	Reported crimes 2011
Burgenland (Burgenland)	9306	10391
Carinthia (Kärnten)	30192	29710
Lower Austria (Niederösterreich)	73146	78634
Upper Austria (Oberösterreich)	66141	67477
Salzburg (Salzburg)	29382	30948
Styria (Steiermark)	55167	55472
Tyrol (Tirol)	44185	45944
Vorarlberg (Vorarlberg)	20662	20611
Vienna (Wien)	207564	200820

Source: http://www.bmi.gv.at/cms/BK/publikationen/krim_statistik/files/2011/KrimStat_Entwicklung_2011.pdf [24.10.2016].

Task:

Determine the relative change in crime cases of Burgenland reported in the year 2011 compared to the year 2010.

[0/1 point]

Task 14

Financial Growth

An amount of € 100,000 is invested at a fixed annual interest rate. The table below provides information about the growth of the investment. In this table, x_n gives the value of the investment after n years ($n \in \mathbb{N}$).

n in years	x_n in euros
0	100000
1	103000
2	106090
3	109272.7

Task:

Suggest an equation that can be used to determine the value of the investment x_{n+1} based on the value of the investment x_n.

x_{n+1} = ____

[0/1 point]

Task 15

Values of a Derivative Function

Let $f\colon \mathbb{R} \to \mathbb{R}$ be a function with equation $f(x) = 3 \cdot e^x$.

Task:

The statements given below refer to the properties of the function f or its derivative function f'.
Put a cross next to each of the two true statements.

There is one point $x \in \mathbb{R}$ for which $f'(x) = 2$.	☐
For all $x \in \mathbb{R}$, $f'(x) > f'(x + 1)$ holds.	☐
For all $x \in \mathbb{R}$, $f'(x) = 3 \cdot f(x)$ holds.	☐
There is one point $x \in \mathbb{R}$ for which $f'(x) = 0$.	☐
For all $x \in \mathbb{R}$, $f'(x) \geq 0$ holds.	☐

[0/1 point]

Task 16

Antiderivative

Let $f\colon \mathbb{R} \to \mathbb{R}$ be a function with equation $f(x) = a \cdot x^3$ with $a \in \mathbb{R}$.

Task:

Determine a such that the function $F\colon \mathbb{R} \to \mathbb{R}$ with equation $F(x) = 5 \cdot x^4 - 2$ is an antiderivative of f.

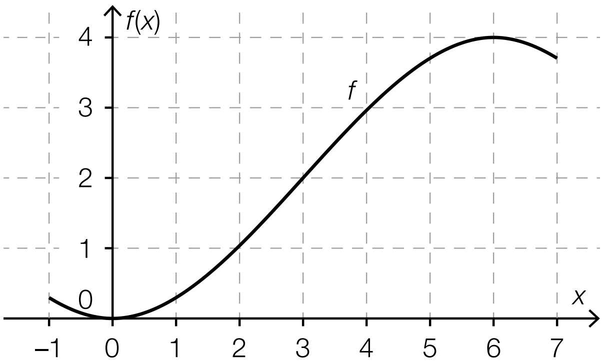
$a =$ ____

[0/1 point]

Task 17

Polynomial Function

The following diagram depicts the graph of a third degree polynomial function $f\colon \mathbb{R} \to \mathbb{R}$ in the interval [–1, 7]. The x-coordinates of all local maxima and minima and the point of inflexion of f in the interval [–1, 7] are integers and can be read from the diagram.



Task:

Put a cross next to each of the two correct statements about the function f.

$f''(3) = 0$	☐
$f'(1) > f'(3)$	☐
$f''(1) = f''(5)$	☐
$f''(1) > f''(4)$	☐
$f'(3) = 0$	☐

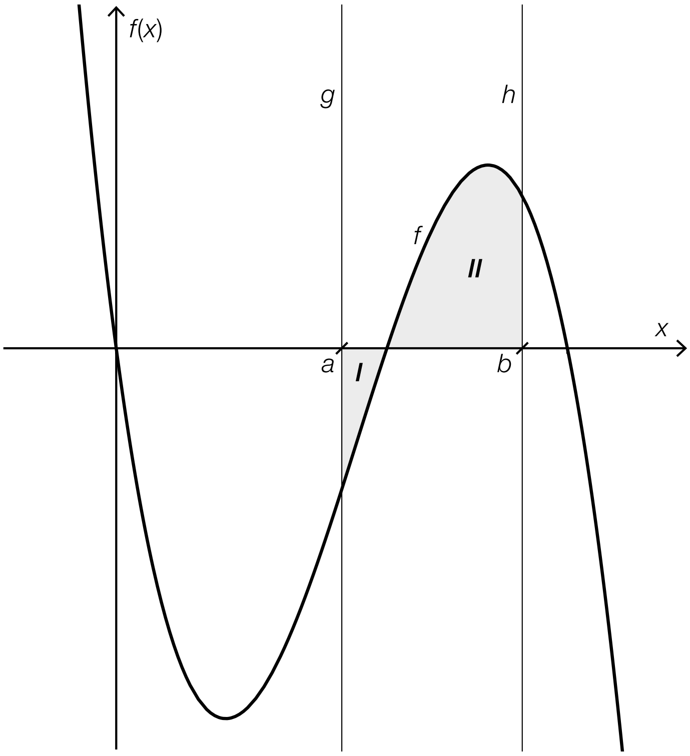
[0/1 point]

Task 18

Areas of Regions

The diagram below shows the graph of the function $f\colon \mathbb{R} \to \mathbb{R}$ and two shaded regions.

The graph of the function f, the x-axis and the line g with equation $x = a$ enclose region ***I*** with area A_1.
The graph of the function f, the x-axis and the line h with equation $x = b$ enclose region ***II*** with area A_2.



Task:

Write down the definite integral $\int_a^b f(x)\,\mathrm{d}x$ using the areas A_1 and A_2.

$\int_a^b f(x)\,\mathrm{d}x =$ ______________________________________

[0/1 point]

Task 19

Leisure Behaviour of Teenagers

400 teenagers were asked about their leisure behaviour. Among all respondents, 330 stated that they belong to a sports club, 146 stated that they play an instrument and 98 stated that they belong to a sports club and play an instrument as well.

The results of this survey have been documented in the following table.

	plays an instrument	does not play an instrument	total
belongs to a sports club	98		330
does not belong to a sports club			
total	146		400

Task:

Determine the relative frequency *h* of the teenagers that were asked who neither belong to a sports club nor play an instrument.

h = ____

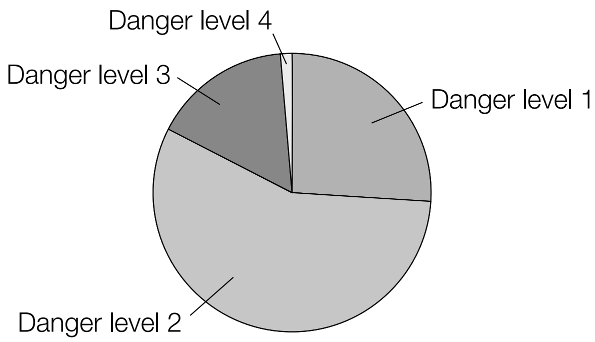
[0/1 point]

Task 20

Danger of Avalanches

During the winter months, the avalanche warning service publishes a daily *avalanche report*. This includes an assessment of the risk of avalanches according to five danger levels.

In a particular region, records of the danger levels were made during the winter of 2013/14. These records give a list of all the days with the according danger level 1 to 4. (There is no entry for danger level 5 in this list, as there was no day with danger level 5 during this period.)
The following diagram shows the relative proportion of days with the respective danger level.



Task:

Justify why danger level 2 has to be the median of the data set that the diagram above is based on.

[0/1 point]

Task 21

Dice

A dice, where the sides are numbered 1, 2, 3, 4, 5 and 6, is used in a game. The dice is thrown three times. The following statement holds for each throw: the probability of any number being rolled is the same as for any other number.

Task:

Determine the probability p that a number that is divisible by 3 is thrown on the third throw.

p = ____

[0/1 point]

Task 22

Frequency of Side Effects

Pharmaceutical companies are obliged to list all known side effects of a medication on the package leaflet. The information on the frequency of side effects are based on the following categories:

Frequency	Occurrance of Side Effects
Very common	More than 1 in 10 people under treatment experience side effects.
Common	Between 1 to 10 in 100 people under treatment experience side effects.
Uncommon	Between 1 to 10 in 1 000 people under treatment experience side effects.
Rare	Between 1 to 10 in 10 000 people under treatment experience side effects.
Very rare	Fewer than 1 in 10 000 people under treatment experience side effects.
Unknown	The frequency of side effects cannot be estimated based on the information available.

In the package leaflet of a medication, one particular side effect is categorised as "rare". 50 000 people are treated with this medication independently from each other. A certain number of people experience this side effect.

Task:

Use the information given on the frequency of side effects above as probabilities and determine the minimum number of people expected to experience this side effect.

[0/1 point]

Task 23

Strike Probability

In a training session, a basketball player throws the ball at the basket six times in a row. If the ball falls into the basket, it is called strike. The probability of a strike for this player is 0.85 for each throw (irrespective of other throws).

Task:

Match each of the four events with the term (from among A to F) which describes the probability of this event occurring.

The player strikes exactly once.	
The player strikes not more than once.	
The player strikes at least once.	
The player strikes exactly twice.	

A	$1 - 0.85^6$
B	$0.15^6 + \binom{6}{1} \cdot 0.85^1 \cdot 0.15^5$
C	$1 - 0.15^6$
D	$0.85^6 + \binom{6}{1} \cdot 0.85^5 \cdot 0.15^1$
E	$6 \cdot 0.85 \cdot 0.15^5$
F	$\binom{6}{2} \cdot 0.85^2 \cdot 0.15^4$

[0/½/1 point]

Task 24

Confidence Interval

Someone wants to determine the unknown proportion p of voters who are going to vote for candidate A in an election and hires an opinion research institute to give an estimate of the proportion p. In the course of this estimation, 200 samples of the same size are drawn. For each of these samples, the respective 95 % confidence interval is determined.

Task:

Determine the expected number of intervals that contain the unknown proportion p.

[0/1 point]

Continue overleaf

Task 25 (Part 2)

System Reliability

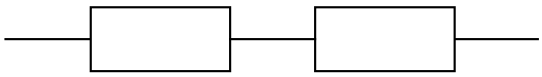
A system is defined as a machine that consists of more than one component. There is a certain probability that each component of a system may function correctly or that it might fail. If individual components fail to work, it depends on the design of the system whether the system as a whole continues to work or whether it fails as well.

The *reliability of a component* is the probability that the component functions correctly, i. e. does not break down. This holds true for a certain period of time and under certain conditions.

The *reliability of a system* is the probability that the system functions correctly. (It is assumed that breakdowns of components happen independently of one another.) The probability of the complementary event is called probability of failure.

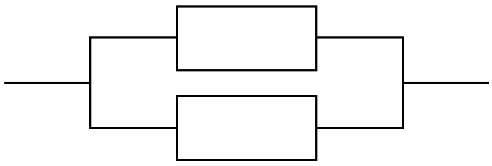
We distinguish between two simple types of systems:

- series systems:



  A series system functions only when all its components function.

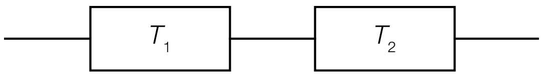
- parallel systems:



  A parallel system functions when at least one of its components functions.

Task:

a) The following system A is given:



Let p_1 be the probability of component T_1 and p_2 be the probability of component T_2.

Consider the reliability of system A as a function z_A in terms of p_1 and p_2.

$\boxed{\text{A}}$ Write down $z_A(p_1, p_2)$.

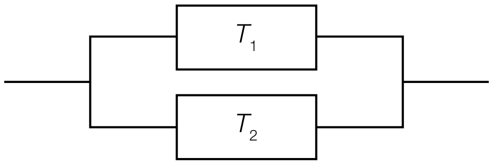
$z_A(p_1, p_2) =$ ____

The components of a different system with the same design have the same reliabilities $p_1 = p_2 = 0.7$. The probability of failure is to be reduced to a quarter of the current probability of failure.

Write down which value the reliability p_{new} (for both components) needs to take.

$p_{new} =$ ____

b) System B is given:



Both components T_1 and T_2 have the same reliability p.

Consider the reliability of system B as a function z_B of p.

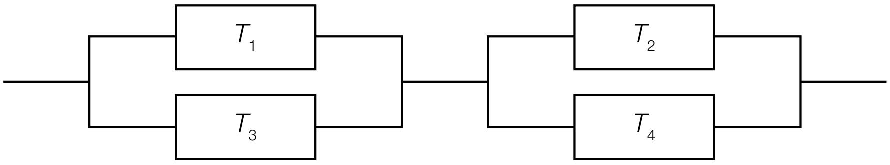
Write down $z_B(p)$.

$z_B(p) =$ ____

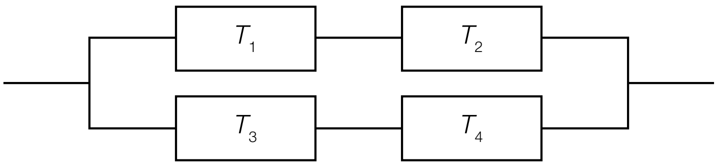
Show by calculation that the function z_B is strictly monotonically increasing in the interval $(0, 1)$.

c) Given are two systems C and D:

System C:



System D:



Every component T_1, T_2, T_3 and T_4 has the same reliability p.

The reliability z_C of system C is a function of p and can be described by the equation $z_C(p) = p^4 - 4 \cdot p^3 + 4 \cdot p^2$.

Determine the quotient $\frac{1 - z_C(0.9)}{1 - z_C(0.8)}$ and interpret this value for system C.

The reliability z_D of system D is a function of p.

Justify why $z_C(p) > z_D(p)$ holds true for all $p \in (0, 1)$.
Use either an equation of z_D or provide justification on basis of the design of systems C and D.

Task 26 (Part 2)

Carpet of Algae

The surface of an 800 m^2 pond is covered with a carpet of algae that continues to grow.
Over the course of five weeks, the area of the carpet is measured at the end of each respective week. All measured values are listed in the table below. At the beginning of measurement, the carpet of algae covers 4 m^2.

t (in weeks)	0	1	2	3	4	5
$A(t)$ (area of the carpet of algae after t weeks in m^2)	4	7	12.25	21.44	37.52	65.65

Mathematically, the growth of the carpet of algae can be modelled in different ways.

Task:

a) In the first five weeks, the area $A(t)$ of the algae carpet can be approximated by an exponential function A, since the carpet covers only a small proportion of the pond ($A(t)$ in m^2, t in weeks).

Determine the percentage by which the area grows each week and write down an equation of A.

$A(t) =$ ____

At the end of the fifth week, 30 m^2 of algae will be harvested. This will be repeated regularly at the end of every following week.

Determine how often this can be repeated, assuming that the area of the carpet continues to grow by the same percentage in between harvests.

b) $\boxed{\text{A}}$ Determine the average weekly change (in m^2 per week) of the area of the algae carpet from the end of the second week until the end of the fourth week of measurement.

The exponential function used above does not describe the growth of the algae well when already a large area is covered, as algae growth will slow down at some point, depending on the size of the pond. A more realistic model will therefore take this aspect into account as well.
Dependent of the area A of the carpet of algae, the rate of growth can be modelled by the function w with equation $w(A) = k \cdot A \cdot (800 - A)$. Here, A is given in m^2; $k \in \mathbb{R}^+$ is the so-called growth parameter, depending on the type of the algae.

Determine the area A_1 of the algae carpet, at which the rate of growth is highest.

$A_1 =$ ____ m^2

c) The observed time period is extended beyond the five weeks mentioned in the introduction. The area of the carpet of algae t weeks after the beginning of the observation is modelled by the function A_2 with equation $A_2(t) = \frac{800}{1 + 199 \cdot e^{-800 \cdot k \cdot t}}$ ($A_2(t)$ in m^2, t in weeks).

Determine the value of the parameter $k \in \mathbb{R}^+$ using the value given in the table at the time $t = 5$.

If this model is used, at which point of time does the carpet of algae cover 90 % of the pond's surface for the first time?
Determine this point of time.

Task 27 (Part 2)

First Names in Austria

Over decades, Statistik Austria, the statistical office of the Republic of Austria, has been collecting the first names that parents give their children. Here, the office only looks at the very first name of a child (if a child is given more than one first name). In addition, certain identical names or names that share the same background, like *Sophie*, *Sofie* and *Sofia*, are grouped together under one name.

For many years now, *Anna* and *Lukas* have been among the most popular names. Out of the children born in the year 2015 (40 777 girls, 43 604 boys), 2 144 girls were named *Anna* and 1 511 boys were named *Lukas*.

Task:

a) For a statistical survey, 30 girls and 30 boys born in the year 2015 are selected randomly.

$\boxed{\text{A}}$ Determine the probability that at least one of the girls in this sample is called Anna.

Determine the probability that in this sample at least one of the girls is called Anna and one of the boys is called Lukas.

b) In the year 1995, the relative proportion of the ten most popular first names for boys was 37.07 %. In 2005, it was 24.28 %. In the year 2015, it was 20.91 %.

This development of the relative proportion of the ten most popular names is described by a quadratic function f with equation $f(t) = a \cdot t^2 + b \cdot t + c$ where $a, b, c \in \mathbb{R}$ and $a \neq 0$.
Here, t stands for the number of years from 1995, thus $f(0) = 0.3707$ holds.

Determine the values of a, b and c and write down an equation of f.

In which year did the relative proportion of the ten most popular names for boys fall below one third for the first time?
Write down the corresponding year.

c) The random variable X models the number of girls born in Upper Austria in the year 2015, who were called *Anna*. This variable is taken to be binomially distributed with parameters $n = 7\,041$ and $p = 0.0526$.

Determine the expectation value μ and the standard deviation σ of the random variable X.

$\mu \approx$ ____

$\sigma \approx$ ____

In fact, in the year 2015, the name *Anna* was chosen most frequently in all nine provinces, whereby the percentage was highest in Upper Austria. In Upper Austria, 7 041 girls were born in 2015. Out of these, 494 were given the first name *Anna*.

$494 - \mu = c \cdot \sigma$ holds for $c \in \mathbb{R}^+$.
Determine c and interpret the value of c in the given context.

Task 28 (Part 2)

Wings for Life World Run

The *Wings for Life World Run* is a fun run taking place in a lot of countries at the same time. One special feature of this run is that no fixed distance has to be covered.

Around the world, all runners start at the same time at 11:00 UTC (Coordinated Universal Time). From the same starting point as the runners, the so-called *Catcher Car* starts 30 minutes later and drives along the course. The car increases its speed according to a pre-defined schedule. Whenever someone is overtaken by the Catcher Car, the race is over for this person. The distance a participant was able to cover until overtaken by the Catcher Car is the result that this person gets.

For the speed of the Catcher Car, the following values were specified until the year 2018 (these serve as a model for the processing of the following tasks):

Time	Speed
from 11:30 to 12:30	15 km/h
from 12:30 to 13:30	16 km/h
from 13:30 to 14:30	17 km/h
from 14:30 to 15:30	20 km/h
from 15:30 to 16:30	20 km/h
from 16:30	35 km/h

Task:

a) A person runs at a constant speed, until he or she is overtaken by the Catcher Car. This person is overtaken during the Catcher Car's 15 km/h phase.
The time t the person spends on the course is dependent of the speed v this person is running at.

Write down an expression that can be used to determine t assuming that v is known (with t in h and v in km/h).

t = ____

In the year 2016, the (constant) speed of one person participating in the run was 9 km/h. One year later, his or her (constant) speed at the event was 10 % higher.

Write down, by what percentage the distance covered by this person until he or she is overtaken by the Catcher Car had thus increased.

The distance covered had thus increased by approximately _______________ %.

b) A particular well-trained person runs at a constant speed during the first hour and takes 5 minutes per kilometre. After that, he or she slows down. From this time on (that is for $t \geq 1$), his or her speed can be modelled by the function v in terms of the time spent running. For the speed $v(t)$, the following equation holds:

$v(t) = 12 \cdot 0.7^{t-1}$ with t in h and $v(t)$ in km/h

Interpret the expression $12 + \int_1^b v(t)\,\mathrm{d}t$ with $b \geq 1$ in the given context.

Determine the time of day, when this person is overtaken by the Catcher Car.

Time: __ __ : __ __ UTC

c) A group of runners is overtaken during the Catcher Car's 20 km/h phase. Juri therefore concludes that this group has not covered less than 40 km and not covered more than 88 km until they being overtaken by the Catcher Car.
Leo replies to this statement, "Your statement is true but I could give you a smaller interval which holds true as well."

$\boxed{\text{A}}$ State whether Leo's claim is correct and justify your decision.

In Vienna's 2017 run, the fastest female participant covered a distance of 51.72 km until she was overtaken by the Catcher Car.

Determine her average speed $\overline{v}$.

$\overline{v}$ = ____ km/h