

Program of the preliminary exam Wiskunde A

Valid from December 2018

The preliminary exam Wiskunde A is taken as a written examination with open questions. The exam time is 3 hours. Information about the exam dates and registration for these exams can be found on www.ccvx.nl.

The program of the preliminary exam Wiskunde A of the CCVW is based on the program wiskunde A of the Dutch VWO for 2019 as published on www.examenblad.nl. Compared to the Central Exam of VWO there are two important differences:

1. **At the preliminary exam Wiskunde A, graphing calculators or any other ICT devices may not be used.**
2. **The domain Statistics and Probability Theory is also tested at the preliminary exam Wiskunde A.** In the Dutch VWO exam, this domain is only tested at the School Exam.

The further determination of the VWO examination program on www.examenblad.nl is therefore not applicable.

In this document you will find

- The exam program
- Exam supplies
- The formula list that is printed on the exam
- Elaboration of the exam program in a list of concepts, characteristics and skills
- Overview of algebraic skills
- Recommended learning materials

In preliminary exam all calculations must be performed algebraically, the use of a **graphing calculator** or a calculator with the possibility to calculate integrals is therefore **not allowed**.

The use of a standard calculator with exponential, logarithmic and trigonometric functions of a type similar to the Casio fx 82 series and the TI 30 series is permitted.

Exam program

This is a translation of the official program in Dutch. If there are any discrepancies between the text below and the Dutch version of this text, the Dutch version will prevail.

- 1 The candidate can analyse suitable problem situations in mathematical terms, solve them and translate the result back to the relevant context.
- 2 The candidate masters the mathematical skills appropriate to the examination program, including modelling and algebraizing, organizing and structuring, analytical thinking and problem solving, manipulating formulas, abstracting, and logical reasoning.
- 3 The candidate can perform calculations with numbers and variables, using arithmetic and algebraic basic operations and working with brackets.
- 4 The candidate can recognize and use the characteristics in graph, table and formula of first-degree functions, second-degree functions, power functions, exponential functions, logarithmic functions and sine functions.
- 5 The candidate can draw up and edit formulas and functional rules of combinations and assemblies of the types of functions mentioned in 4, draw the corresponding graphs, solve equations and inequalities with algebraic methods, thus without the use of a graphing calculator, and interpret the result in terms of a context.
- 6 The candidate can determine the derivative of first-degree functions, second-degree functions, power functions, exponential functions and logarithmic functions, use the rules for differentiation and describe the change behaviour of a function on the basis of the derivative. The use of the chain rule is limited to functions of the form $k(x) = f(g(x))$ in which f and g are single functions of the types mentioned in the previous sentence.
- 7 By means of the derived function, the candidate can calculate the position of the minima and the maxima of a graph by solving the associated equations algebraically and can determine the nature of these extremes by means of a sketch of the graph.
- 8 The candidate can recognize and describe the behaviour of a sequence and perform calculations on a sequence, especially for arithmetic and geometric sequences.
- 9 The candidate can structure counting problems and schematisation and use the result of this in calculations and reasoning.
- 10 The candidate can determine the mode and the median of a series of discrete numerical data and can use a simple calculator to calculate the mean and standard deviation of a population of limited size.
- 11 The candidate can use the concept of chance to determine the probability of a certain outcome or event in a random chance process by means of a probability (tree) diagram, of combinatorics and of laws of probabilities.
- 12 The candidate can set the probability distribution for random variables with a limited number of outcomes and calculate the expected value and the standard deviation.
- 13 The candidate can determine whether a binomial probability distribution is applicable in a given situation, indicate the parameters of this probability distribution and use the corresponding formulas to calculate probabilities, expected value and standard deviation.
- 14 The candidate can use the parameters of the normal distribution, i.e. the mean (or the expected value) and the standard deviation, and can use the rules of thumb for the location of 68% and 95% of the observations.

- 15 The candidate can determine the expected value and the standard deviation of the sum of two independent random variables and can determine the expected value and the standard deviation of the sum and the average of the results of n independent repetitions of the same random experiment.
- 16 The candidate can set up a statistical testing procedure from a suitable problem situation and thereby
- indicate whether it concerns a test of the mean or a proportion test
 - formulate the null hypothesis
 - indicate whether the procedure must be carried out left-sided, right sided or two-sided
 - indicate how a given sample result must be converted to a p-value
 - interpret the given value of a p-value
- calculate the boundaries of the rejection region (the critical region) with the table in the formula list and interpret the given sample result using these boundaries.

The translation of the next section is still in progress.

Tentamenbenodigdheden

Naar het tentamen moet u meenemen:

- Identiteitsbewijs
Paspoort, rijbewijs, Europese ID kaart, verblijfsdocument
- Schrijfgerei: pen
Een potlood mag alleen gebruikt worden voor het tekenen van grafieken.
- Liniaal of geodriehoek
- Rekenmachine met exponentiële, logaritmische en goniometrische functies
Grafische rekenmachines en rekenmachines met de mogelijkheid om integralen te berekenen zijn **niet toegestaan**.
- Een horloge (geen smartwatch) of een klok (niet de klok van uw telefoon)
- Eten en drinken

Zorg ervoor dat u de juiste rekenmachine meeneemt. Als u alleen een grafische rekenmachine bij u heeft, dan zult u het tentamen zonder rekenmachine moeten maken.

Formula list

This list will be printed on the last pages of the preliminary exam Wiskunde A

Quadratic equations

The solutions of the equation $ax^2 + bx + c = 0$ with $a \neq 0$ and $b^2 - 4ac \geq 0$ are

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \quad \text{and} \quad x = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

Differentiation

Rule	function	derivative function
Sum rule	$s(x) = f(x) + g(x)$	$s'(x) = f'(x) + g'(x)$
Product rule	$p(x) = f(x) \cdot g(x)$	$p'(x) = f'(x) \cdot g(x) + f(x) \cdot g'(x)$
Quotient rule	$q(x) = \frac{f(x)}{g(x)}$	$q'(x) = \frac{f'(x) \cdot g(x) - f(x) \cdot g'(x)}{(g(x))^2}$
Chain rule	$k(x) = f(g(x))$	$k'(x) = f'(g(x)) \cdot g'(x)$ or $\frac{dk}{dx} = \frac{df}{dg} \cdot \frac{dg}{dx}$

Logarithms

Rule	conditions
${}^g\log a + {}^g\log b = {}^g\log ab$	$g > 0, g \neq 1, a > 0, b > 0$
${}^g\log a - {}^g\log b = {}^g\log \frac{a}{b}$	$g > 0, g \neq 1, a > 0, b > 0$
${}^g\log a^p = p \cdot {}^g\log a$	$g > 0, g \neq 1, a > 0$
${}^g\log a = \frac{{}^p\log a}{{}^p\log g}$	$g > 0, g \neq 1, a > 0, p > 0, p \neq 1$

Arithmetic and geometric sequences

Arithmetic sequence:	$Sum = \frac{1}{2} \cdot \text{number of terms} \cdot (u_e + u_l)$
Geometric sequence:	$Sum = \frac{u_{l+1} - u_e}{r - 1} \quad (r \neq 1)$
<i>In both formulas:</i>	$e = \text{number first term of the sum}; \quad l = \text{number last term of the sum}$

Probability

If X and Y are any random variables, then: $E(X + Y) = E(X) + E(Y)$

If furthermore X and Y are independent, then: $\sigma(X + Y) = \sqrt{\sigma^2(X) + \sigma^2(Y)}$

\sqrt{n} -law:

For n independent repetitions of the same experiment where the result of each experiment is a random variable X , the sum of the results is a random variable S and the mean of the results is a random variable \bar{X} .

$$E(S) = n \cdot E(X)$$

$$\sigma(S) = \sqrt{n} \cdot \sigma(X)$$

$$E(\bar{X}) = E(X)$$

$$\sigma(\bar{X}) = \frac{\sigma(X)}{\sqrt{n}}$$

Binomial Distribution

If X has a binomial distribution with parameters n (number of experiments) and p (probability of success at each experiment), then

$$P(X = k) = \binom{n}{k} \cdot p^k \cdot (1 - p)^{n-k} \quad \text{with } k = 0, 1, 2, \dots, n$$

Expected value: $E(X) = np$

Standard deviation: $\sigma(X) = \sqrt{n \cdot p \cdot (1 - p)}$

n and p are the parameters of the binomial distribution

Normal Distribution

If X is a normally distributed random variable with mean μ and standard deviation σ , then

$$Z = \frac{X - \mu}{\sigma} \text{ has a standard normal distribution and } P(X < g) = P\left(Z < \frac{g - \mu}{\sigma}\right)$$

μ and σ are the parameters of the normal distribution.

Hypothesis testing

In a testing procedure where the test statistic T is normally distributed with mean μ_T standard deviation σ_T the boundaries of the rejection region (the critical region) are::

α	left sided	right sided	two sided
0.05	$g = \mu_T - 1.645\sigma_T$	$g = \mu_T + 1.645\sigma_T$	$g_l = \mu_T - 1.96\sigma_T$ $g_r = \mu_T + 1.96\sigma_T$
0.01	$g = \mu_T - 2.33\sigma_T$	$g = \mu_T + 2.33\sigma_T$	$g_l = \mu_T - 2.58\sigma_T$ $g_r = \mu_T + 2.58\sigma_T$

Elaboration of the exam program

Below, the exam program is further elaborated in a list of concepts, properties and skills. This list is intended as a support in preparing for the preliminary exam, but not as a replacement for the exam program. Although this list has been compiled with the greatest possible care, it may therefore occur that an exam question is not dealt with in this list.

Concept / property / skill	Remark / explanation
Various calculations	
Computations with percentages; percentual change	$\frac{New - Old}{Old} \times 100\%$
Scientific notation	$0.0000123 = 1.23 \times 10^{-5}$
Computations with fractions	Addition, subtraction, multiplication Adding fractions with unlike denominators Simplifying fractions Dividing fractions
Ratios	In a table of ratios the cross products are equal
Computations with variables:	<i>For example:</i>
Eliminating parentheses	$(a + b)(c + d) - (e + f) =$ $ac + ad + bc + bd - e - f$
Solve for a variable	$y = \frac{1}{x + 1} \Leftrightarrow x = \frac{1}{y} - 1$
Computations with units	The train runs 12 km in 5 minutes. That is 2,4 km/minute Or 40 m/s Or 144 km/h

<p>Powers, roots and radicals</p> <p>a^n is a power with base number a and exponent n</p> <p>$\sqrt[n]{a}$ is the number of which the n-th power equals a</p>	<p>n is a rational number (a fraction)</p> <p>$n = 2, 3, 4, 5, \dots$</p> <p>If n is even, then $a \geq 0$ and $\sqrt[n]{a} \geq 0$</p>
<p>Special exponents</p> <p>$a^2 = a \cdot a$; $a^3 = a \cdot a \cdot a$ etc.</p> <p>$a^1 = a$</p> <p>$a^0 = 1$</p> <p>$a^{-n} = \frac{1}{a^n} = \left(\frac{1}{a}\right)^n$</p> <p>$a^{\frac{1}{n}} = \sqrt[n]{a}$</p>	<p>$a \neq 0$</p> <p>$a \neq 0$</p> <p>$a^{-1} = \frac{1}{a^1} = \frac{1}{a}$</p> <p>$n = 2, 3, 4, 5, \dots$</p> <p>If n is even, then $a \geq 0$ and $a^{\frac{1}{n}} \geq 0$</p> <p>$a^{\frac{1}{2}} = \sqrt[2]{a} = \sqrt{a}$</p>
<p>Calculation rules for powers</p> <p>$a^m \cdot a^n = a^{m+n}$</p> <p>$\frac{a^m}{a^n} = a^{m-n}$</p> <p>$(a^m)^n = a^{m \cdot n}$</p> <p>$(a \cdot b)^n = a^n \cdot b^n$</p> <p>$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$</p>	<p>$a^{\frac{m}{n}} = a^{\frac{1}{n} \cdot m} = \left(a^{\frac{1}{n}}\right)^m = \left(\sqrt[n]{a}\right)^m$</p> <p>$(a + b)^2 \neq a^2 + b^2$</p>

<p>Straight lines and linear relations</p> <p>General equation: $mx + ny = c$</p> <p>$n = 0$ yields a vertical line</p> <p>$m = 0$ yields a horizontal line</p> <p>The equation of a non-vertical line can also be written in the form $y = ax + b$</p> <p>Slope of the line through the points $A(x_A, y_A)$ and $B(x_B, y_B)$:</p> $\frac{\Delta y}{\Delta x} = \frac{y_B - y_A}{x_B - x_A}$ <p>Drawing up an equation with the slope</p> <p>Computing the intersection of two straight lines</p> <p>Interpolation and extrapolation</p> <p>Direct proportionality and inverse proportionality</p>	<p>The line with equation $3x + 4y = 12$ passes through $(4,0)$ and $(0,3)$</p> <p>$3x + 0 \cdot y = 12$ yields $x = 4$</p> <p>$0 \cdot x + 4y = 12$ yields $y = 3$</p> <p>$3x + 4y = 12$ yields $y = -\frac{3}{4}x + 3$</p> <p>This is equal to a in the formula $y = ax + b$</p> <p>Substitute the slope and the coordinates of a point in the formula $y = ax + b$</p> <p>Eliminate y from the system of two equations</p>
<p>Power relations</p> <p>$y = ax^n$ with n even</p> <p>$y = ax^n$ with n odd</p> <p>Horizontal shift</p> <p>Vertical shift</p> <p>Rescaling in vertical direction</p>	<p>The graph has a vertex in $(0,0)$</p> <p>$(0,0)$ is the point of symmetry of the graph</p> <p>$y = 3(x - 4)^2 + 5$ is obtained from the graph of $y = x^2$ by tripling the y-coordinates, followed by shifting the graph 4 units to the right and 5 units upwards. This results in an upwards opening parabola with vertex $(4,5)$.</p>

<p>Growth formulas</p>	
<p><i>Exponential growth with initial value b and growth factor g</i></p> <p>The graph of $N(t) = g^t$ is increasing for $g > 1$ and decreasing for $0 < g < 1$</p> <p>Growth factor and growth percentage</p> <p>Converting a growth percentage to a different unit of time</p> <p>Doubling time for $g > 1$</p> <p>Half-life for $0 < g < 1$</p>	<p>$N(t) = b \cdot g^t$</p> <p>En “ontaard” voor $g = 1$</p> <p>Via the growth factor</p> <p>Also computing the growth factor for a certain unit of time from the doubling time / half-life</p>
<p><i>Other growth formulas</i></p> <p>$N(t) = a(1 - g^t)$</p> <p>$N(t) = \frac{a}{1 + c \cdot g^t}$</p>	<p>For $0 < g < 1$, for both formulas the graphs are increasing to a, the boundary (the saturation level)</p>

<p>Logarithms</p> <p>$y = {}^g\log(x)$ means $g^y = x$</p> <p>${}^g\log(1) = 0$; ${}^g\log(g) = 1$; ${}^g\log(g^n) = n$</p> <p>$\log(x) = {}^{10}\log(x)$</p> <p>The graph is increasing for $g > 1$ and decreasing for $0 < g < 1$</p>	<p>$g > 0, g \neq 1; x > 0$</p> <p>$\log(1) = 0$; $\log(10) = 1$; $\log(100) = 2$</p> <p>If x approaches 0, the graphs approach the y-axis</p>
<p>Calculation rules for logarithms</p> <p>${}^g\log(a) + {}^g\log(b) = {}^g\log(a \cdot b)$</p> <p>${}^g\log(a) - {}^g\log(b) = {}^g\log\left(\frac{a}{b}\right)$</p> <p>${}^g\log(a^n) = n \cdot {}^g\log(a)$</p> <p>${}^g\log(a) = \frac{{}^p\log(a)}{{}^p\log(g)}$</p>	<p>These follow from the calculation rules for powers</p> <p>This holds for all numbers n</p> <p>Often used with $p = 10$ to compute logarithms with the log key of a calculator</p>

<p>Differentiation: the derivatives of standard functions</p> <p>$f(x) = a$ yields $f'(x) = 0$</p> <p>$f(x) = ax$ yields $f'(x) = a$</p> <p>$f(x) = ax^n$ yields $f'(x) = n \cdot x^{a-1}$</p> <p>$f(x) = e^x$ yields $f'(x) = e^x$</p> <p>$f(x) = g^x$ yields $f'(x) = g^x \cdot \ln(g)$</p> <p>$f(x) = \ln(x)$ yields $f'(x) = \frac{1}{x}$</p>	<p>The derivative is also noted as $\frac{dy}{dx}$</p> <p>From the sum rule we get: $f(x) = ax + b$ yields $f'(x) = a$</p> <p>This also holds when n is a fraction or a negative number.</p> <p>$e \approx 2,71828$</p> <p>$\ln(g) = {}^e\log(g) \quad (g > 0)$</p> <p>From the constant factor rule we get: $f(x) = g \log(x)$ yields $f'(x) = \frac{1}{x \ln(g)}$</p>
<p>Rules for differentiation of combinations of functions</p> <p>Constant factor rule</p> <p>Sum rule</p> <p>Product rule</p> <p>Quotient rule</p> <p>Chain rule</p>	<p>$g(x) = c \cdot f(x)$ yields $g'(x) = c \cdot f'(x)$</p> <p><i>The other rules are in the formula list</i></p>
<p>Applications of the derivative</p> <p>$f'(a)$ is the slope of the (tangent to the) graph of f in point $(a, f(a))$</p> <p>The graph is increasing if $f'(x) > 0$ and decreasing if $f'(x) < 0$</p> <p>In a minimum or a maximum, $f'(x) = 0$</p> <p>Minima and maxima together are called extremes</p> <p>The points where the graph has a minimum or a maximum are called the vertices of the graph.</p> <p>Minimal and maximal rate of growth</p>	<p>The points where f could have a maximum or a minimum are determined by solving $f'(x) = 0$. In principle you further have to check in which of these points the graph has a minimum and in which point the graph has a maximum.</p> <p><i>This often follows from the wording of the question.</i></p> <p>The derivative (the rate of growth) can be differentiated as well</p>

Sequences	
Direct formula	Computes a term based on its number
Recursive formula	Computes a term based on the previous term
Arithmetic sequence	Recursive formula: $u_{n+1} = u_n + a$ Direct formula: $u_n = u_0 + a \cdot n$ Or: $u_n = u_1 + a \cdot (n - 1)$
Geometric sequence	Recursive formula: $u_{n+1} = r \cdot u_n$ Direct formula: $u_n = r^n \cdot u_0$ Or: $u_n = r^{n-1} \cdot u_1$
Sum formula of an arithmetic sequence Sum formula of a geometric sequence	<i>See the formula list</i>
Computing the number of a term	This is done by putting the direct formula equal to the value of the term.

Sinus functions	
General formula: $f(x) = A + B \cdot \sin(C \cdot (x - D))$	$A =$ equilibrium $ B =$ amplitude
The graph is a sinusoid	$C = \frac{2\pi}{\text{period}}$
Read the equilibrium, the amplitude, the period and a starting point from the graph	If $B > 0$ the graph passes the equilibrium increasing in point (D, A) (a starting point)
Determine the equilibrium, the amplitude, the period and a starting point from the formula	
Use the period and the symmetry around the minimum and the maximum	

Descriptive Statistics

This subject is only dealt with superficially in the preliminary Wiskunde A

Mode, median, mean and standard deviation for a series of discrete numerical data

Mean and standard deviation for a frequency distribution

Mean and standard deviation may be computed with the statistic functions of an ordinary calculator

Counting systematically

A.k.a. combinatorics

Visualisation

E.g. tree diagram, contingency table, venn diagram

Multiplication rule

I AND II

Addition rule

I OR II (exclusive)

With or without repetition

Permutations, factorials

The order of the objects matters

Combinations

The order of the objects does not matter

Pascal's triangle

The number of codes with 5 A's and 3 B's is on the 8th row of Pascal's triangle and is equal to

$$\binom{8}{3} = \binom{8}{5} = \frac{8!}{3! \cdot 5!} = 56$$

Combination of techniques

The number of codes with 3 A's, 4 B's and 5 C's is given by $\binom{12}{3} \cdot \binom{9}{4}$

(and by $\binom{12}{5} \cdot \binom{7}{4}$)

<p>Probability</p> <p>An event is a part of all possible outcomes of a random experiment</p> <p>Laplace's definition of probability for random experiments with equally likely outcomes</p> <p>Empiric probabilities are determined with relative frequencies</p> <p>Conditional probabilities</p> <p>Independent events</p> <p>Multiplication rule for independent events</p> <p>Addition law for mutually exclusive events</p> <p>Complement rule</p> <p>Application of these laws and rules for combined random experiments</p>	<p>Is often indicated with a capital letter, such as G, A and B.</p> $P(G) = \frac{\text{number of outcomes satisfying } G}{\text{total number of outcomes}}$ <p>Theoretical probabilities are often determined by counting systematically</p> <p>Are often determined with a contingency table</p> $P(A B) = P(A)$ $P(G_1 \text{ and } G_2) = P(G_1) \cdot P(G_2)$ $P(G_1 \text{ or } G_2) = P(G_1) + P(G_2)$														
<p>Random variables</p> <p>If the results of a random experiment are numbers, you can write down the corresponding probabilities using a random variable.</p> <p>The probability distribution is a list of all possible outcomes of a random variable with the associated probabilities</p> <p>Expected value (or expectation); Expected value of a sum = sum of the expected values</p> <p>Standard deviation</p> <p>Standard deviation of the sum and the mean of independent random variables; \sqrt{n}-law</p>	<p>If X is the number of eyes on a roll with a die, then we note the probability of 4 eyes with $P(X = 4)$</p> <p>The probability distribution is often noted in a table, for example</p> <table border="1" data-bbox="817 1482 1294 1579"> <tr> <td>x</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td>$P(X = x)$</td> <td>$\frac{1}{6}$</td> <td>$\frac{1}{6}$</td> <td>$\frac{1}{6}$</td> <td>$\frac{1}{6}$</td> <td>$\frac{1}{6}$</td> <td>$\frac{1}{6}$</td> </tr> </table> $E(X) = 1 \cdot \frac{1}{6} + 2 \cdot \frac{1}{6} + \dots + 6 \cdot \frac{1}{6}$ $E(X + Y) = E(X) + E(Y)$ <p>May be computed with the statistical functions of a calculator</p> <p><i>See the formula list</i></p>	x	1	2	3	4	5	6	$P(X = x)$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$
x	1	2	3	4	5	6									
$P(X = x)$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$									

<p>The binomial distribution</p> <p>Bernoulli trial</p> <p>Binomial random experiment</p> <p>Single probabilities (probability of k successes)</p> <p>Cumulative probabilities</p> <p>Expected value</p> <p>Standard deviation</p>	<p>Outcome: “success” or “failure”</p> <p>Parameters: n = number of Bernoulli trials $p = P(\text{success})$ at each trial</p> $P(X = k) = \binom{n}{k} \cdot p^k \cdot (1 - p)^{n-k}$ <p>$P(X \leq k)$; $P(X \geq k)$; $P(k \leq X \leq l)$ Only for a sum of at most 3 simple probabilities</p> $E(X) = np$ $\sigma_X = \sqrt{np(1 - p)}$
<p>The normal distribution</p> <p>The normal distribution and the Gaussian curve as an approximation of a frequency distribution</p> <p>Rules of thumb</p> <p>Computing μ and/or σ using the rules of thumb</p>	<p>Parameters: μ or μ_X = mean (expected value) σ or σ_X = standard deviation</p> <p>50% of the observations are below the mean</p> <p>68% of the observations are between $\mu - \sigma$ en $\mu + \sigma$; 95% of the observations are between $\mu - 2\sigma$ en $\mu + 2\sigma$</p> <p>E.g. given that 84% of a population weighs more than 80 kg and 2.5 of this population weighs more than 110 kg.</p>
<p>Normal approximation</p> <p>A discretely distributed random variable can often be approached with a normal distribution</p> <p>The mean and standard deviation of the normal approach are the expected value and the standard deviation of the discrete random variable.</p> <p>Continuity correction</p>	<p>For a binomially distributed random variable, this is the case when $np \geq 5$</p> <p>Thus, for the normal approximation Y of a binomially distributed random variable with parameters n and p, we get: $\mu_Y = np$ and $\sigma_Y = \sqrt{np(1 - p)}$</p> $P(X \leq k) = P\left(X < k + \frac{1}{2}\right)$

<p>Hypothesis testing</p> <p>Deriving the type of test procedure and the accompanying null hypothesis from a description</p> <p>Deriving the alternative hypothesis</p> <p>Deriving the test statistic and its parameters</p> <p>Level of significance</p> <p>Decision based on a p-value</p> <p>Decision by comparing the sample result with the boundary of the rejection region (the critical region)</p>	<p>Proportion test (binomial test) with null hypothesis $H_0: p = p_0$ or mean test (normal test) with null hypotheses $H_0: \mu = \mu_0$</p> <p>Left sided, right sided or two sided</p> <p>The parameters for a binomial test are n and p_0, the parameters for a normal test are μ_0 and σ, use the \sqrt{n}-law to compute σ</p> <p>Usually $\alpha = 0.05$, sometimes $\alpha = 0.01$</p> <p>Since the use of graphing calculators and tables is forbidden, the p-value usually will be given at the preliminary exam Wiskunde A</p> <p>The boundaries for a normal test can be calculated with the formulas from the formula list. If $np_0 \geq 5$, you can also use these formulas with a binomial test. In this situation, you do not have to use the continuity correction</p>
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Algebraic skills

Below an overview of algebraic skills that the candidates for the examination mathematics A of the CCVW must master. Though this list has been compiled with the utmost care too, it may occur that a skill that is included the exam program, is not included in this list

Skill	Remark / explanation
Solving standard equations	
First degree	$ax + b = px + q$
Quadratic <i>With the quadratic formula</i>	$ax^2 + bx + c = 0$ <i>If possible, factorising can be used as well</i>
Power equations with positive even exponents	$x^n = a \Leftrightarrow x = \pm \sqrt[n]{a} \quad (a \geq 0)$
Power equations with positive odd exponents	$x^n = a \Leftrightarrow x = \sqrt[n]{a}$
Other power equations	$x^n = a \Leftrightarrow x = a^{\frac{1}{n}} \quad (a \geq 0)$
Equations with roots	$\sqrt{x} = a \Leftrightarrow x = a^2 \quad (x \geq 0; a \geq 0)$
Solving suitable exponential and logarithmic equations exactly	${}^g\log(g^n) = a \Leftrightarrow g^n = g^a \Leftrightarrow n = a$
Solving exponential equations using logarithms	$g^x = a \Leftrightarrow x = {}^g\log(a)$
Solving inequalities	When solving inequalities graphically, the intersections of the graphs have to be computed algebraically
Solving systems of equations	By elimination and/or substitution
Setting the equation of a straight line	Determine the slope and substitute this together with to coordinates of one point into one of the standard formula

<p>Rewriting equations and formulas</p> <p>Splitting an equation</p> <p>Factorising using a common factor</p> <p>Expanding parentheses</p> <p>Operations with fractions</p> <p>Operations with roots</p> <p>Applying calculation rules</p>	<p><i>E.g. to rewrite an equation into a standard equation</i></p> $A \cdot B = 0 \Leftrightarrow A = 0 \vee B = 0$ $A^2 = B^2 \Leftrightarrow A = \pm B$ $A \cdot B = A \cdot C \Leftrightarrow A = 0 \vee B = C$ $A \cdot B + A \cdot C = A(B + C)$ $(A + B)(C + D) = AC + AD + BC + BD$ <p>Addition (also of fractions with unlike denominators)</p> <p>Multiplication and division</p> <p>Crosswise multiplication:</p> $\frac{A}{B} = \frac{C}{D} \Leftrightarrow AD = BC \wedge BD \neq 0$ $\sqrt{A} = B \Leftrightarrow A = B^2 \wedge A \geq 0$ <p>Like those for powers and logarithms</p>
<p>Combining formulas</p>	<p>If e.g. the price per piece p and the cost c both depend on the quantity q, then you can derive formulas for the revenue: $r = pq$ and for the profit::</p> $\pi = r - c = pq - c$ <p>Take care of the right use of parentheses when substituting formulas for p and c.</p>
<p>Rewriting formulas with logarithms</p> <p>Change of base</p> <p>Solving an exponential or logarithmic equation for a variable</p> <p>Converting ${}^g\log(N) = at + b$ into a formula of the form $N = B \cdot G^t$ and vice versa</p> <p>Converting ${}^g\log(N) = a + b \cdot {}^g\log(t)$ into a formula of the form $N = A \cdot t^b$ and vice versa</p>	<p>Use the fourth calculation rule</p> <p>Use $Y = {}^g\log(X) \Leftrightarrow g^Y = X$</p> $B = g^b; G = g^a$ $A = g^a$

Recommended learning materials

Unfortunately, as far as we know there are no textbooks in English covering the full program of the Dutch VWO exam wiskunde A. However, there is a textbook that covers most of the calculus topics (functions and derivatives):

Mathematics that works volume 1 (De Gee, ISBN 978-90-5041-167-7)

From this book you can skip the sections that cover antidifferentiation and integrals.

The topics Combinatorics, Statistics and Probability theory are covered in many textbooks on basic statistics. Be sure that the topics indicated in this document are covered in a book before you buy it!

There is also a wide range of materials available online, for instance the Kahn academy. You can use Google to find more information on a certain topic.

And last but not least, check the example exams on www.ccvx.nl