

## Mathematics subject curriculum

Dette er ei omsetjing av den fastsette læreplanteksten. Læreplanen er fastsett på Nynorsk

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Utgått

## **Purpose**

Mathematics is part of our global cultural heritage. Throughout the ages, humankind has used and developed mathematics to explore the universe, to systematise experiences and to understand relationships in nature and society. Another source of inspiration for the development of the subject has been the joy people have felt when simply working with mathematics. The subject is part of many vital areas in society, including medicine, economics, technology, communication, energy management and construction. Proficiency in mathematics is thus a prerequisite for the development of society. An active democracy requires citizens who are able to study, to understand and to critically evaluate quantitative information, statistical analyses and economic prognoses. Hence mathematical proficiency is required to understand and influence processes in society.

Problem solving is a part of mathematical proficiency; it means analysing and transforming a problem into mathematical form, solving it and assessing its validity. This also has linguistic aspects, such as reasoning and communicating ideas. Aids and technology are used in most mathematical activities. Both being able to use and to evaluate aids and technology and recognising their limitations are important aspects of the subject. Proficiency in mathematics is an important tool for each individual, and the subject can form the basis for pursuing further education and for participation in working life and recreational activities. Mathematics underpins important elements of our cultural history and the development of logical thinking. In this way, the subject plays a key role in general education by influencing identity, ways of thinking and self-understanding.

The mathematics subject in school helps the pupil develop mathematical proficiency needed by society and by each individual. To attain proficiency, pupils must be allowed to work both theoretically and practically. The teaching of mathematics alternates between inquiry-based, playful, creative and problem-solving activities and skills training. Mathematics shows its usefulness in practical applications and as a tool in technology and design. Central ideas, forms, structures and relations in the subject are utilised in learning activities. Both girls and boys must be given the opportunity to gain rich experiences that create positive attitudes towards and competence in the subject. In this way, the foundation for lifelong learning is laid.

## **Structure**

The subject has been organized into main areas for which competence aims have been formulated. These main subject areas supplement each other and must be considered together.

This subject is a common core subject for upper secondary education programmes. Learning in the subject shall therefore be made as relevant as

possible by adapting each subject to its education programme as much as possible.

Mathematics has competence aims after the second, fourth, seventh and tenth year levels in compulsory and after Vg1 (the first year) and Vg2 (the second year) in programmes for general studies and vocational education programmes in upper secondary education.

There are two subject curricula for Vg1. Curriculum T is more theoretical, while Curriculum P is more practical.

Both curricula qualify candidates for higher education together with either the common core subject Mathematics at level Vg2 (2T/2P) or the programme subject Mathematics (R1/S1).

Pupils taking the vocational subjects shall have three fifths of their Vg1 curriculum in 1T or 1P.

1T-Y: main subject areas

number and algebra (competence aims 1, 2, 3 and 5)

geometry (the entire main subject area)

functions (competence aims 1, 2 and 4)

1P-Y: main subject areas

number and algebra

geometry

economics

#### Overview of main subject areas:

Year	Main subject areas					
1-4	Number	Geometry	Measurement	Statistics		
5-7	Number and algebra	Geometry	Measurement	Statistics and probability		
8-10	Number and algebra	Geometry	Measurement	Statistics, probability and combinatorics	Functions	
1T	Number and algebra	Geometry		Probability	Functions	
1P	Number and algebra	Geometry		Probability	Functions	Economics
1T-Y	Number and algebra	Geometry			Functions	

1P-Y	Number and algebra	Geometry				Economics
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## Main subject areas

### Number and algebra

The main subject area number and algebra is about developing number sense and insight into how numbers and calculation with numbers are part of systems and patterns. With numbers it is possible to quantify amounts and sizes. Numbers include integers, fractions, decimal numbers and percentages. Algebra in school generalises calculation with numbers by representing numbers with letters or other symbols. This makes it possible to describe and analyse patterns and relationships. Algebra is also used in the main subject areas geometry and functions.

### Geometry

School geometry focuses on analysing characteristics of two- and three-dimensional figures and carrying out geometric constructions and calculations. Dynamic processes are studied, such as reflection, rotation and translation. The main subject area also includes executing and describing location and movement.

### Measurement

Measurement means comparing and often assigning a numerical quantity to an object or an amount. This process requires the use of measurement units and suitable techniques, measuring tools and formulas. Evaluating measurement results and deliberating measurement uncertainty are important elements of the process.

### Statistics, probability and combinatorics

Statistics covers planning studies and collecting, organizing, analysing and presenting data. One aspect of data analysis includes describing general characteristics of the data material. Assessing and critically evaluating conclusions and representations of data are key elements in statistics. Calculus of probability focuses on expressing the likelihood of an event by a number. Combinatorics involves finding systematic ways of determining numbers, and is often required for calculating probability.

### Functions

A function unambiguously describes change or development of a quantity that depends on another. Functions may be represented in a number of ways,

for example using formulas, tables and graphs. Function analysis involves looking for special characteristics, such as the rate of change and when the development reaches particular values.

## Economics

The main subject area *economics* focuses on calculations and assessments of economic conditions.

## Teaching hours

Teaching hours are given in 60-minute units:

### PRIMARY SCHOOL

Years 1 to 4: 560 teaching hours

Years 5 to 7: 328 teaching hours

### LOWER SECONDARY SCHOOL

Years 8 to 10: 313 teaching hours

### PROGRAMMES FOR GENERAL STUDIES

Vg1: 140 teaching hours

### VOCATIONAL EDUCATION PROGRAMMES

Vg1: 84 teaching hours

## Basic skills

Basic skills are integrated in the competence aims where they contribute to developing competence in the subject, while also being part of this competence. In the mathematics subject the basic skills are understood as follows:

*Being able to express oneself orally* in the mathematics subject means forming an opinion, asking questions, reasoning, arguing and explaining a line of thought using mathematics. This also means engaging in conversation, communicating ideas and discussing and elaborating on problems and solution strategies with others.

*Being able to express oneself in writing* in the mathematics subject means using mathematics to solve problems, describing a way of thinking and explaining discoveries and ideas. One makes drawings, sketches, figures,

tables and graphs. Furthermore, mathematical symbols and the formal mathematical language are used.

*Being able to read* in the mathematics subject means interpreting and making use of texts with mathematical content and content from everyday life and working life. Such texts may include mathematical expressions, graphs, tables, symbols, formulas and logical reasoning.

*Numeracy* in the mathematics subject is the foundation of the mathematics subject. This involves problem solving and inquiry, based on practical, everyday situations and mathematical problems. To manage this, pupils must be familiar with and master the arithmetic operations, be able to use varied strategies, make estimates and evaluate how reasonable the answers are.

*Being able to use digital tools* in the mathematics subject involves using these tools for games, investigation, visualisation and publication, and also involves learning how to use and assess digital aids for problem solving, simulation and modelling. It is also important to find information, to analyse, process and present data with appropriate aids, as well as to be critical about sources, analyses and results.

## Competence aims

### Competence aims after Year 2

#### Number

*The aims of the studies are to enable pupils to*

- count to 100, decompose and compose amounts up to 10, compose and decompose by tens
- use the real number line for calculations and demonstrate the magnitude of numbers
- make estimates of amounts, count, compare numbers and express number magnitudes in varied ways
- develop and use varied arithmetic strategies for addition and subtraction of double digit numbers
- double and halve
- recognise, talk about and further develop structures in simple number patterns

#### Geometry

*The aims of the studies are to enable pupils to*

- recognise and describe characteristics of simple two- and three-dimensional figures in connection with corners, edges and surfaces, and sort and name the figures according to these characteristics
- recognise and use reflection symmetry in practical situations
- compose and explore simple geometrical patterns and describe them orally

## Measurement

*The aims of the studies are to enable pupils to*

- compare quantities of length and area using suitable measurement units
- name days, months and simple times of day
- recognise Norwegian coins and use them when buying and selling

## Statistics

*The aims of the studies are to enable pupils to*

- collect, sort, record and display simple data with tally charts, tables and bar charts

## Competence aims after Year 4

### Number

*The aims of the studies are to enable pupils to*

- describe the place-value system for nonnegative integers, use positive and negative integers, easy fractions and decimal numbers in practical contexts, and represent numbers in varied ways
- estimate and find numbers by means of mental computation, counting aids and paper and pencil, make rough estimations with simple numbers and evaluate answers
- develop and use a variety of methods for addition and subtraction of multi-digit numbers, including mental strategies and paper and pencil
- use the multiplication table up to  $10 \times 10$  and carry out multiplication and division in practical contexts
- choose an arithmetic operation and justify the choice, use knowledge of tables of the arithmetic operations and utilise simple relations between the arithmetic operations
- experiment with, recognise, describe and extend simple number patterns

## Geometry

*The aims of the studies are to enable pupils to*

- recognise and describe characteristics of circles, polygons, spheres, cylinders and simple polyhedrons
- draw and build geometric figures and models in practical contexts, including technology and design
- recognise and use reflection symmetry and parallel translation in specific situations
- make and explore geometric patterns and describe them orally
- place and describe locations in grids, on maps and in coordinate systems, with and without digital tools

## Measurement

*The aims of the studies are to enable pupils to*

- estimate and measure length, area, volume, mass, temperature, time intervals and angles
- use non-standard measurement units and explain the purpose of standard measurement units, and convert between common measurement units
- compare quantities using suitable measuring tools and simple calculations with and without digital aids
- solve practical buying and selling tasks

## Statistics

*The aims of the studies are to enable pupils to*

- collect, sort, record and display data using tally charts, tables and bar charts, and comment on the displays

## Competence aims after Year 7

### Number and algebra

*The aims of the studies are to enable pupils to*

- describe the place-value system for decimal numbers, calculate with positive and negative integers, decimal numbers, fractions and percentages, and place them on the number line
- find common denominators and carry out addition, subtraction and multiplication of fractions
- develop and use methods for mental computation, rough estimation and written calculations, and also use a calculator when appropriate

- describe reference system and notation used in formulas in spreadsheets, and use spreadsheets to carry out and present/display simple calculations
- set up and explain calculations and procedures, and argue for solution methods
- explore and describe structures and changes in simple geometric and numeric patterns

## Geometry

*The aims of the studies are to enable pupils to*

- analyse characteristics of two- and three-dimensional figures and describe objects from technology and everyday life using geometric terms
- build three-dimensional models and draw perspectives with one vanishing point
- describe and carry out mirroring, rotation and parallel displacement
- use coordinates to describe location and movement in a coordinate system on paper and digitally
- use coordinates to calculate distances parallel with the axes in a coordinate system

## Measurement

*The aims of the studies are to enable pupils to*

- select suitable measuring tools and carry out practical measurements in connection with day-to-day life and technology, and assess the results based on precision and measuring uncertainty
- estimate and measure quantities of length, area, mass, volume, angle and time, and use time and time intervals in simple calculations
- choose suitable measurement units and convert between different measurement units
- explain the structure of measurement units for area and volume and calculate perimeter and area, surface area and volume of simple two- and three-dimensional figures
- use a scale to calculate distances and produce simple maps and working drawings
- use proportions in practical connections, calculate velocity and convert between currencies

## Statistics and probability

*The aims of the studies are to enable pupils to*

- plan and collect data in connection with observations, questionnaires and experiments
- represent data in tables and graphs produced digitally and by hand, and read, interpret and evaluate their usefulness
- find median, mode and mean for simple data sets and evaluate them in relation to each other
- evaluate chance in everyday contexts, games and experiments and calculate probability in simple situations

## Competence aims after Year 10

### Number and algebra

*The aims of the studies are to enable pupils to*

- compare and convert between integers, decimal numbers, fractions, percentages, per mil (per thousands) and numbers in standard form, and represent such numbers in varied ways
- calculate with fractions, carry out division of fractions and simplify fractions
- use factors, powers, square roots and prime numbers in calculations
- develop, use and justify the rationale for methods of mental computation, rough estimations and written calculations with regards to the four arithmetic operations
- process and factor simple algebraic expressions, and carry out calculations with formulas, brackets and fractions with single term denominator
- solve first order equations and inequalities and simple systems of equations with two unknowns
- compose simple budgets and perform calculations related to personal finances
- use, with and without digital aids, numbers and variables in inquiry, experimentation, practical and theoretical problem solving and technology and design projects

### Geometry

*The aims of the studies are to enable pupils to*

- analyse characteristics of two- and three-dimensional figures, both digitally and by hand, and use them in constructions and calculations
- perform and explain geometric constructions and representations with ruler and compass and other aids
- use similarity and the Pythagorean theorem to calculate unknown sizes/quantities
- interpret and compose working drawings and perspective drawings with several vanishing points by using various aids

- use coordinates to represent figures and find characteristics of geometric forms
- explore, experiment with and formulate logical reasoning by means of geometric ideas, and elaborate on geometric relations that are particularly important in technology, art and architecture

## Measurement

*The aims of the studies are to enable pupils to*

- estimate and calculate length, perimeter, angle, area, surface area, volume and time, and use and change scales
- choose appropriate measurement units, explain relationships and convert between different measurement units, use and assess measuring instruments and measuring methods for practical measuring, and discuss and elaborate on precision and measuring uncertainty
- elaborate on the number  $\pi$  and use it for calculating circumference, area and volume

## Statistics, probability and combinatorics

*The aims of the studies are to enable pupils to*

- carry out investigations and use databases to search for and analyse statistical data and critically assess sources
- order and group data, find and discuss and elaborate on the median, mode, mean and variance, and display data with and without digital tools
- determine probabilities in everyday contexts and games by experimenting, simulating and calculating
- describe sample space and represent probability as fraction, percentage and decimal number
- demonstrate, using examples, and find the possible solutions to simple combinatorics problems

## Functions

*The aims of the studies are to enable pupils to*

- compose, on paper and digitally, functions that describe numerical relationships and practical contexts, interpret them and convert between varied representations of functions, such as graphs, tables, formulas and text
- identify and make use of characteristics of proportional, inversely proportional, linear and elementary quadratic functions, and provide examples of situations that may be described by these functions

## Competence aims after 1T - Education Programme for General Studies

### Number and algebra

*The aims of the studies are to enable pupils to*

- interpret, process and evaluate the mathematical content in various texts
- use mathematical methods and aids to solve problems from various subjects and other areas
- calculate with powers with rational exponents and numbers in standard form, algebraic expressions, formulas, expressions with brackets and alphanumeric rational and quadratic expressions, and use quadratic equations to factor algebraic expressions
- solve equations, inequalities and systems of equations of first and second order and simple equations with exponential and logarithmic functions, using paper and pencil and digital aids
- convert a practical problem into an equation, an inequality or a system of equations, solve it and evaluate the validity of the solution

### Geometry

*The aims of the studies are to enable pupils to*

- elaborate on the definitions of sine, cosine and tangent and use trigonometry to calculate length, angles and area of triangles
- use plane geometry to analyse and solve composite theoretical and practical problems regarding lengths, angles and areas

### Probability

*The aims of the studies are to enable pupils to*

- formulate, experiment with and discuss and elaborate on simple uniform and non-uniform probability models
- calculate probability using systematic representations, and use the addition rule and the multiplication rule
- use independent and conditional probability in simple situations
- compose binomial probability models based on practical examples, and calculate binomial probability using formulas and digital aids

### Functions

*The aims of the studies are to enable pupils to*

- elaborate on the function concept and draw graphs by analysing the function concept
- determine roots, intersections and average rate of change, find approximate values for instantaneous rates of change and provide some practical interpretations of these aspects
- elaborate on the definition of the derivative, use the definition to deduce a rule for the derivative of polynomial functions and use this rule to discuss functions
- compose and interpret functions that describe practical problems, analyse empirical functions and find expressions for an approximate linear function
- use digital aids to discuss and elaborate on polynomial functions, rational functions, exponential functions and power functions

## Competence aims after 1P - Education Programme for General Studies

### Number and algebra

*The aims of the studies are to enable pupils to*

- estimate answers, calculate practical tasks, with and without technical aids, and evaluate how reasonable the results are
- interpret, process, evaluate and discuss the mathematical content of written, oral and graphic presentations
- interpret and use formulas that apply to everyday life, working life and the education programme area
- calculate with proportions, percentages, percentage points and growth factors
- deal with proportional and inversely proportional magnitudes in practical contexts

### Geometry

*The aims of the studies are to enable pupils to*

- use similarity, scale and the Pythagorean theorem in calculations and practical work
- solve practical problems involving length, angle, area and volume
- calculate using different measurement units, use different measuring tools and evaluate measurement accuracy
- interpret and prepare working drawings, maps, sketches and perspective drawings related to working life, art and architecture

### Probability

*The aims of the studies are to enable pupils to*

- make examples and simulations of random events and explain the concept of probability
- calculate probability by counting the number of favourable and the number of possible outcomes using tables, by systematising counts and by using the addition rule and the multiplication rule in practical contexts

## Functions

*The aims of the studies are to enable pupils to*

- examine functions that describe practical situations, by determining the intersections, zeros, extremes and gradient, and interpret the practical value of the results
- convert between different representations of functions
- elaborate on the concept of linear growth, demonstrate the progress of such growth and use this in practical examples, also by using digital aids

## Economics

*The aims of the studies are to enable pupils to*

- calculate using price indexes, currencies, real wages and nominal wages
- calculate wages, and compose budgets and accounts using various tools
- calculate taxes
- examine and evaluate consumption and various terms for loans and savings using web-based consumer calculators

## Competence aims after 1T-Y – Vg1 Vocational Education Programme

### Number and algebra

*The aims of the studies are to enable pupils to*

- interpret, process and evaluate the mathematical content in various texts
- use mathematical methods and aids to solve problems from various subjects and other areas
- calculate with powers with rational exponents and numbers in standard form, algebraic expressions, formulas, expressions with brackets and alphanumeric rational and quadratic expressions, and use quadratic equations to factor algebraic expressions

- convert a practical problem into an equation, an inequality or a system of equations, solve it and evaluate the validity of the solution

## Geometry

*The aims of the studies are to enable pupils to*

- elaborate on the definitions of sine, cosine and tangent and use trigonometry to calculate length, angles and area of triangles
- use plane geometry to analyse and solve composite theoretical and practical problems regarding lengths, angles and areas

## Functions

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- elaborate on the function concept and draw graphs by analysing the function concept
- determine roots, intersections and average rate of change, find approximate values for instantaneous rates of change and provide some practical interpretations of these aspects
- compose and interpret functions that describe practical problems, analyse empirical functions and find expressions for an approximate linear function

Competence aims after 1P-Y – Vg1 Vocational Education Programme

## Number and algebra

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- estimate answers, calculate practical tasks, with and without technical aids, and evaluate how reasonable the results are
- interpret, process, evaluate and discuss the mathematical content of written, oral and graphic presentations
- interpret and use formulas that apply to everyday life, working life and the education programme area
- calculate with proportions, percentages, percentage points and growth factors
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## Assessment

Provisions for final assessment:

### **Overall achievement grades**

<b>Year</b>	<b>Provision</b>
Year 10	Pupils shall have one overall achievement grade.
Vg1 vocational education programme Vg1 education programme for general studies	Pupils shall have one overall achievement grade.

### **Examinations for pupils**

<b>Year</b>	<b>Provision</b>
Year 10	Pupils may be selected for a written examination. The written examination is prepared and graded centrally. Pupils may also be selected for an oral examination. The oral examination is prepared and graded locally.
Vg1 vocational education programmes	Pupils may be selected for a written or oral examination. The written examination is prepared and graded centrally. The oral examination is prepared and graded locally.
Vg1 education	Pupils may be selected for a written or oral examination. The written examination is prepared and graded centrally. The oral

programme for general studier	examination is prepared and graded locally.
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**Examinations for external candidates**

Year	Provision
Year 10	See the provision in force for primary and lower secondary education for adults.
Vg1 vocational education programmes	External candidates shall sit for a written examination. The examination is prepared and graded locally.
Vg1 education programme for general studies	External candidates shall sit for a written examination. The examination is prepared and graded centrally.

The general provisions on assessment have been laid down in the Regulations relating to the Norwegian Education Act.