# TEST SUMMARY AND FRAMEWORK

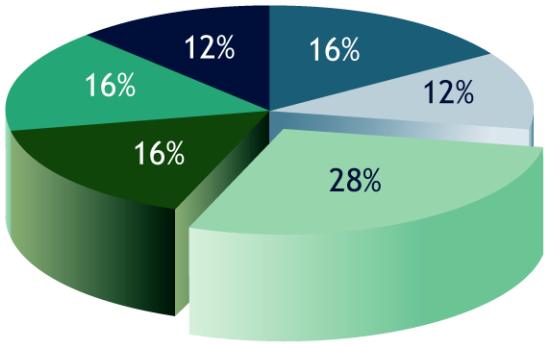
## TEST SUMMARY

## MATHEMATICS

The Washington Educator Skills Tests—Endorsements™ (WEST-E™) are designed to measure a candidate's knowledge of the subject-area content contained in the test framework for each field. All WEST-E tests are fully aligned with the state's teacher endorsement competencies and, as applicable, the Essential Academic Learning Requirements.

This test summary describes general testing information as well as the approximate percentage of the total test score derived from each content domain. The test framework, organized by content domain, contains the objectives that define the content for the test.

| | |
|---|---|
| **Test Format** | Multiple-choice questions |
| **Number of Questions** | Approximately 110 |
| **Test Session** | Up to 5 hours (examinees may take more than one test per session) |
| **Passing Score** | 240 (scores are calculated in a range from 100 to 300) |
| **Test Code** | 026 |




| Key | Approximate Percentage of Test | Content Domain | Range of Objectives |
|---|---|---|---|
| | 16% | Mathematical Process | 0001-0004 |
| | 12% | Numbers and Operations | 0005-0007 |
| | 28% | Algebra and Functions | 0008-0014 |
| | 16% | Measurement and Geometry | 0015-0018 |
| | 16% | Statistics, Probability, and Discrete Mathematics | 0019-0022 |
| | 12% | Calculus | 0023-0025 |

# TEST FRAMEWORK

# MATHEMATICS

## MATHEMATICAL PROCESS

**0001 Demonstrate understanding of reasoning and proof.**

For example:

- identifying, selecting, and using various types of reasoning (e.g., inductive, deductive)
- making and supporting mathematical conjectures
- disproving false conjectures
- developing and evaluating logical arguments
- developing and evaluating mathematical proofs

**0002 Demonstrate understanding of mathematical communication.**

For example:

- using clear and precise mathematical language and symbols
- analyzing and evaluating the mathematical thinking and strategies of others
- converting between standard American English and mathematical language, notation, and symbols (e.g., in word problems)
- organizing and representing information using multiple representations (e.g., algebraic, numerical, graphic, visual)

**0003 Demonstrate understanding of mathematical problem solving.**

For example:

- identifying and executing necessary mathematical procedures to solve problems
- selecting, applying, and translating among various representations to solve problems
- selecting and using various technologies for mathematical problem solving (e.g., spreadsheets, dynamic graphing tools, dynamic statistical packages, graphing calculators)
- solving problems that arise in mathematics and in real-world contexts

**0004 Demonstrate understanding of mathematical connections and of the history of mathematics.**

For example:

- relating concepts and procedures from different strands of mathematics (e.g., geometric representations of algebraic concepts)
- using mathematical modeling to solve problems from other disciplines and in real-world contexts
- demonstrating knowledge of the historical development of mathematics
- demonstrating knowledge of the contributions of various cultures to the development of mathematics

## NUMBERS AND OPERATIONS

**0005 Demonstrate understanding of number representations.**

For example:

- using and comparing numbers in multiple representations (e.g., fractions, decimals, percents, scientific notation, powers, roots)
- using numbers in multiple bases (e.g., conversions between bases, operations in multiple bases)
- representing and using complex numbers
- using vectors to represent length and direction

**0006 Demonstrate understanding of mathematical operations.**

For example:

- identifying properties of the real numbers (e.g., commutative, associative, distributive, transitive) and applying them to arithmetic and algebraic operations
- performing arithmetic operations on vectors and matrices
- applying estimation strategies to determine feasibility of answers
- solving problems using various number operations, including ratio and proportion

**0007 Demonstrate understanding of number theory.**

For example:

- applying the fundamental theorem of arithmetic to analyze the prime factorization of numbers
- analyzing the characteristics of prime and composite numbers, factors, and divisibility
- solving problems involving least common multiples
- solving problems involving greatest common factors

## ALGEBRA AND FUNCTIONS

**0008 Demonstrate understanding of properties of functions and relations.**

For example:

- analyzing and extending patterns
- identifying and analyzing characteristics (e.g., domain, range, symmetry) of functions and relations
- identifying and analyzing transformations (e.g., shifts, stretches, reflections) of functions and relations
- identifying and analyzing inverses of functions

**0009 Demonstrate understanding of properties of linear functions.**

For example:

- analyzing the relationships among tabular, symbolic, and graphic representations of linear functions
- solving systems of linear equations and inequalities using various methods
- interpreting the meanings of intercept and slope in real-world applications
- using linear functions to model and solve problems in real-world contexts

**0010 Demonstrate understanding of properties of quadratic functions.**

For example:

- analyzing the relationships among tabular, symbolic, and graphic representations of quadratic functions
- solving quadratic equations and inequalities using various methods
- solving systems of quadratic equations and inequalities using various methods
- analyzing the quantity and nature of the roots of quadratic equations
- using quadratic functions to model and solve problems in real-world contexts

**0011 Demonstrate understanding of properties of polynomial, rational, radical, absolute-value, and piecewise-defined functions.**

For example:

- analyzing the relationships among tabular, symbolic, and graphic representations of polynomial, rational, radical, absolute-value, and piecewise-defined functions
- manipulating polynomial, rational, radical, and absolute-value expressions
- solving polynomial, rational, radical, and absolute-value equations and inequalities using various methods
- analyzing nonlinear functions in terms of discontinuities, asymptotes, roots, intervals of increase and decrease, and end behavior
- using polynomial, rational, radical, absolute-value, and piecewise-defined functions to model and solve problems in real-world contexts

**0012 Demonstrate understanding of properties of exponential and logarithmic functions.**

For example:

- analyzing the relationships among tabular, symbolic, and graphic representations of exponential and logarithmic functions
- manipulating exponential and logarithmic expressions
- solving exponential and logarithmic equations and inequalities using various methods
- using exponential and logarithmic functions to model and solve problems in real-world contexts

**0013 Demonstrate understanding of properties of trigonometric functions.**

For example:

- analyzing the relationships among tabular, symbolic, and graphic representations of trigonometric functions
- manipulating trigonometric expressions and identities
- solving trigonometric equations using various methods
- using trigonometric functions to model and solve problems in real-world contexts

**0014 Demonstrate understanding of linear algebra.**

For example:

- using matrices to represent and solve systems of linear equations
- analyzing the inverses of matrices
- solving matrix equations
- representing transformations of the plane by matrix multiplication

## MEASUREMENT AND GEOMETRY

**0015 Demonstrate understanding of principles of measurement.**

For example:

- using a variety of units (e.g., U.S. standard, metric, degree, radian) and representations for measuring
- using appropriate tools, techniques, and formulas to determine direct and indirect measurements in a variety of contexts
- solving problems involving length, perimeter, area, volume, mass, capacity, density, time, and rates of change
- applying the laws of sines and cosines and right-triangle trigonometry to solve problems
- analyzing the effect of changes in dimensions on perimeter, area, and volume
- using error analysis and precision to determine the reliability of numbers obtained from measurements

**0016 Demonstrate understanding of principles of axiomatic systems and geometric proof.**

For example:

- identifying and using methods of direct and indirect proof
- using the formal axiomatic system of Euclidean geometry to construct and analyze proofs
- analyzing the relationships among theorems, postulates, definitions, and undefined terms
- demonstrating knowledge of the differences among Euclidean and non-Euclidean geometries (e.g., spherical, elliptic, hyperbolic)

**0017 Demonstrate understanding of principles of Euclidean geometry.**

For example:

- applying the properties of parallel and perpendicular lines to solve problems
- applying Euclidean theorems (e.g., Pythagorean theorem, triangle inequality) to triangles
- applying Euclidean theorems to quadrilaterals, other polygons, and circles
- using properties of symmetry, congruence, and similarity to solve problems
- analyzing and justifying geometric constructions with a compass and straightedge

**0018 Demonstrate understanding of principles of coordinate and transformational geometry.**

For example:

- representing two- and three-dimensional figures in appropriate coordinate systems
- using concepts and properties of slope, midpoint, parallelism, perpendicularity, and distance to analyze figures in the coordinate plane
- identifying, analyzing, and graphing equations of conic sections
- applying and analyzing transformations using translations, reflections, and rotations
- using the techniques of coordinate geometry to model and solve problems

## STATISTICS, PROBABILITY, AND DISCRETE MATHEMATICS

**0019 Demonstrate understanding of principles of sampling and descriptive statistics.**

For example:

- identifying and applying techniques for collecting representative and unbiased data
- organizing and displaying data in various formats (e.g., tables, graphs, box-and-whisker plots, histograms)
- calculating, using, and interpreting measures of central tendency, shape, and spread of data distributions (e.g., mean, median, standard deviation)
- calculating and interpreting percentiles
- interpreting various representations of data (e.g., tables, graphs, box-and-whisker plots, histograms)

**0020 Demonstrate understanding of principles of inferential statistics.**

For example:

- drawing conclusions from data and statistics
- recognizing valid and invalid uses of statistics
- using correlation to analyze the relationship between two variables
- determining and interpreting confidence intervals
- designing and interpreting statistical experiments to investigate real-world problems (e.g., hypothesis testing)

**0021 Demonstrate understanding of principles of probability.**

For example:

- calculating simple and conditional probabilities of dependent and independent events using the addition and multiplication rules and combinatorics
- using different representations (e.g., Venn diagrams, tree diagrams) to calculate probabilities
- calculating geometric probabilities
- solving problems involving normal probability distributions
- using simulations to estimate experimental probabilities of real-world events

**0022 Demonstrate understanding of principles of discrete mathematics.**

For example:

- applying combinatorics in mathematical and in real-world contexts
- applying graph theory in mathematical and in real-world contexts
- using recurrence relations to describe sequences
- applying linear programming in mathematical and in real-world contexts
- using finite differences to analyze sequences

## CALCULUS

**0023 Demonstrate understanding of basic concepts of calculus.**

For example:

- applying the concepts of limits and continuity to algebraic functions
- interpreting average rate of change as the slope of a secant line
- solving problems involving average rates of change
- using algebraic and geometric techniques to approximate the area under a curve (e.g., Riemann sum)
- analyzing the convergence of sequences and series

**0024 Demonstrate understanding of principles of differential calculus.**

For example:

- recognizing the derivative of a function at a point as the limit of the slope of a secant line to the graph of that function at that point (e.g., difference quotient)
- interpreting the derivative of a function at a point as the instantaneous rate of change of that function at that point
- applying basic techniques of differentiation, including the power rule, product rule, quotient rule, chain rule, and implicit differentiation
- using first and second derivatives to investigate the behavior of a function
- using concepts of differential calculus and mathematical modeling to represent and solve problems in real-world contexts

**0025 Demonstrate understanding of principles of integral calculus.**

For example:

- interpreting the definite integral as the area under a curve when appropriate
- applying basic techniques of integration
- applying the fundamental theorem of calculus to compute the value of a definite integral
- applying the fundamental theorem of calculus to calculate the derivative of a function defined as an integral
- using concepts of integral calculus and mathematical modeling to represent and solve problems in real-world contexts