CSET®

California
Subject
Examinations for
Teachers®

TEST GUIDE

MATHEMATICS
SUBTEST III

Subtest Description

This document contains the Mathematics subject matter requirements arranged according to the domains covered by Subtest III of CSET: Mathematics. In parentheses after each named domain is the CTC-assigned domain code from the Mathematics subject matter requirements.

Mathematics
Subtest III: Calculus

Part I: Content Domains for Subject Matter Understanding and Skill in Mathematics

CALCULUS (SMR Domain 5)

Candidates demonstrate an understanding of trigonometry and calculus as outlined in the California Common Core Content Standards for Mathematics (High School). Candidates demonstrate a depth and breadth of conceptual knowledge to ensure a rigorous view of trigonometry and calculus and their underlying structures. They apply the concepts of trigonometry and calculus to solving problems in real-world situations.

0001   Trigonometry (SMR 5.1)

a. Prove that the Pythagorean Theorem is equivalent to the trigonometric identity $\sin^2 x + \cos^2 x = 1$ and that this identity leads to $1 + \tan^2 x = \sec^2 x$ and $1 + \cot^2 x = \csc^2 x$
b. Prove and apply the sine, cosine, and tangent sum formulas for all real values
c. Analyze properties of trigonometric functions in a variety of ways (e.g., graphing and solving problems, using the unit circle)
d. Apply the definitions and properties of inverse trigonometric functions (i.e., arcsin, arccos, and arctan)
e. Apply polar representations of complex numbers (e.g., DeMoivre's Theorem)
f. Model periodic phenomena with periodic functions
g. Recognize equivalent identities, including applications of the half-angle and double-angle formulas for sines and cosines

(California Common Core Content Standards for Mathematics, including Standards for Mathematical Practice 1–8: Trigonometric Functions, High School [F-TF])

0002   Limits and Continuity (SMR 5.2)

a. Derive basic properties of limits and continuity, including the Sum, Difference, Product, Constant Multiple, and Quotient Rules, using the formal definition of a limit
b. Show that a polynomial function is continuous at a point
c. Apply the intermediate value theorem, using the geometric implications of continuity

(California Common Core Content Standards for Mathematics, including Standards for Mathematical Practice 1–8: Calculus Standards, High School)

**MATHEMATICS
SUBTEST III: CALCULUS**

0003   Derivatives and Applications (SMR 5.3)

a. Derive the rules of differentiation for polynomial, trigonometric, and logarithmic functions using the formal definition of derivative
b. Interpret the concept of derivative geometrically, numerically, and analytically (i.e., slope of the tangent, limit of difference quotients, extrema, Newton's method, and instantaneous rate of change)
c. Interpret both continuous and differentiable functions geometrically and analytically and apply Rolle's theorem, the mean value theorem, and L'Hôpital's rule
d. Use the derivative to solve rectilinear motion, related rate, and optimization problems
e. Use the derivative to analyze functions and planar curves (e.g., maxima, minima, inflection points, concavity)
f. Solve separable first-order differential equations and apply them to growth and decay problems

(California Common Core Content Standards for Mathematics, including Standards for Mathematical Practice 1–8: Calculus Standards, High School)

0004   Integrals and Applications (SMR 5.4)

a. Derive definite integrals of standard algebraic functions using the formal definition of integral
b. Interpret the concept of a definite integral geometrically, numerically, and analytically (e.g., limit of Riemann sums)
c. Prove the fundamental theorem of calculus, and use it to interpret definite integrals as antiderivatives
d. Apply the concept of integrals to compute the length of curves and the areas and volumes of geometric figures

(California Common Core Content Standards for Mathematics, including Standards for Mathematical Practice 1–8: Calculus Standards, High School)

0005   Sequences and Series (SMR 5.5)

a. Derive and apply the formulas for the sums of finite arithmetic series and finite and infinite geometric series (e.g., express repeating decimals as a rational number)
b. Determine convergence of a given sequence or series using standard techniques (e.g., ratio, comparison, integral tests)
c. Calculate Taylor series and Taylor polynomials of basic functions

(California Common Core Content Standards for Mathematics, including Standards for Mathematical Practice 1–8: Seeing Structure in Expressions, High School [A-SSE]; Calculus Standards, High School)

Part II: Subject Matter Skills and Abilities
Applicable to the Content Domains in Mathematics

Candidates for Single Subject Teaching Credentials in mathematics use inductive and deductive reasoning to develop, analyze, draw conclusions, and validate conjectures and arguments. As they reason both abstractly and quantitatively, they use counterexamples, construct proofs using contradictions, construct viable arguments, and critique the reasoning of others. They create multiple representations of the same concept. They know the interconnections among mathematical ideas, use appropriate tools strategically, and apply techniques and concepts from different domains and sub-domains to model the same problem. They explain mathematical interconnections with other disciplines. They are able to communicate their mathematical thinking clearly and coherently to others, orally, graphically, and in writing. They attend to precision, including the use of precise language and symbols.

Candidates make sense of routine and complex problems, solving them by selecting from a variety of strategies. They look for and make use of structure while demonstrating persistence and reflection in their approaches. They analyze problems through pattern recognition, look for and express regularity in repeated reasoning, and use analogies. They formulate and prove conjectures, and test conclusions for reasonableness and accuracy. They use counterexamples to disprove conjectures.

Candidates select and use different representational systems (e.g., coordinates, graphs). They understand the usefulness of transformations and symmetry to help analyze and simplify problems. They model with mathematics to analyze mathematical structures in real contexts. They use spatial reasoning to model and solve problems that cross disciplines.

(California Common Core Content Standards for Mathematics [Grade 7, Grade 8, and High School], including Standards for Mathematical Practice 1–8)