CERTIFICATION EXAMINATIONS FOR OKLAHOMA EDUCATORS™ (CEOE™)

OKLAHOMA SUBJECT AREA TESTS™ (OSAT™)

FIELD 125: MIDDLE LEVEL/INTERMEDIATE MATHEMATICS

TEST FRAMEWORK

September 2016

	Subarea	Range of Competencies
I.	Number Properties and Number Sense	0001–0002
II.	Relations, Functions, and Algebra	0003–0008
III.	Measurement and Geometry	0009–0011
IV.	Probability, Statistics, and Discrete Mathematics	0012–0014
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SUBAREA I—NUMBER PROPERTIES AND NUMBER SENSE

Competency 0001

Apply knowledge of the structure and properties of the real number system.

The following topics are examples of content that may be covered under this competency.

- Recognize the hierarchy of the real number system, its classification into various subsets, and properties of the real number system (e.g., distributive, identities, commutative).
- Analyze the properties of real numbers (e.g., place value) and their representations (e.g., integers, fractions, powers).
- Apply knowledge of radical, exponential, and scientific notation to model and solve problems.
- Evaluate mathematical conjectures, arguments, and informal proofs involving numbers, and use counterexamples to evaluate arguments and disprove suppositions.

Competency 0002

Apply knowledge of number operations and number theory.

The following topics are examples of content that may be covered under this competency.

- Apply operations to real and complex numbers (e.g., integers, fractions, rational exponents) in problem-solving situations.
- Apply different problem-solving strategies (e.g., ratios and proportional reasoning, percentages) in a variety of mathematical contexts.
- Apply knowledge of prime numbers, factors, and divisibility to solve problems.
- Apply knowledge of greatest common factors and least common multiples to model and solve mathematical and real-world problems.
- Model number theory concepts and relationships using a variety of formats (e.g., lists, Venn diagrams, factor trees).

SUBAREA II—RELATIONS, FUNCTIONS, AND ALGEBRA

Competency 0003

Apply the principles and properties of algebraic relations and functions.

The following topics are examples of content that may be covered under this competency.

- Analyze and distinguish between relations and functions using different representations (e.g., tabular, algebraic, graphic).
- Analyze relations and functions and their graphs in terms of domain, range, symmetry, intercepts, maxima, and minima.
- Analyze the effects of transformations such as $f(x + k)$, $f(x) + k$, and $kf(x)$ on the graph of the relation or function $f(x)$.
- Analyze inverse functions and evaluate compositions of functions using functional notation.
- Analyze and develop algebraic generalizations of different types of patterns (e.g., recursive, exponential, sequences and series).

Competency 0004

Apply algebraic techniques.

The following topics are examples of content that may be covered under this competency.

- Convert everyday language into mathematical language, notation, and symbols, and vice versa.
- Analyze given mathematical statements, expressions, or definitions in the context of a mathematical or real-world problem.
- Manipulate algebraic expressions and equations (e.g., factoring, simplifying, transforming).
- Justify algebraic techniques using the properties of the real number system, and evaluate the mathematical thinking and strategies of others.

Competency 0005

Apply the properties of linear functions and relations.

The following topics are examples of content that may be covered under this competency.

- Distinguish between linear and nonlinear data in various contexts (e.g., tables, real-world situations).
- Analyze the relationship between the equation of a line and its graph in mathematical and real-world contexts.
- Determine the equation of a line using different types of information (e.g., two points on the line, the slope and one point on the line).
- Model and solve problems involving linear equations and inequalities using algebraic and graphic techniques.
- Solve systems of linear equations and inequalities in mathematical and real-world contexts using a variety of techniques (e.g., substitution, graphing, linear combination, matrices).

Competency 0006

Apply the properties of quadratic and higher-order polynomial functions and relations.

The following topics are examples of content that may be covered under this competency.

- Analyze relationships between different representations of quadratic and higher-order polynomial functions (e.g., tabular, algebraic, graphic).
- Model and solve problems involving quadratic and higher-order polynomial equations and inequalities using a variety of techniques (e.g., completing the square, factoring, graphing, quadratic formula).
- Analyze the roots of quadratic and higher-order polynomial equations.
- Analyze and use the equations and graphs of circles.

Competency 0007

Apply the principles and properties of radical, rational, absolute value, exponential, and logarithmic functions.

The following topics are examples of content that may be covered under this competency.

- Manipulate and simplify radical, rational, absolute value, exponential, and logarithmic expressions.
- Describe and analyze characteristics of radical, rational, absolute value, exponential, and logarithmic functions and their graphs (e.g., asymptotes).
- Convert algebraic representations of radical, rational, absolute value, exponential, and logarithmic functions into graphic representations, and vice versa.
- Model and solve problems involving radical, rational, absolute value, exponential, and logarithmic equations in mathematical and real-world contexts.

Competency 0008

Apply knowledge of the conceptual foundations of calculus.

The following topics are examples of content that may be covered under this competency.

- Apply the concept of limits to algebraic functions and their graphs.
- Analyze the concept of the derivative with respect to instantaneous rate of change and the concept of the slope of the line tangent to a curve.
- Analyze the concept of the integral with respect to the area under a curve.
- Apply concepts of calculus to model real-world situations.

SUBAREA III—MEASUREMENT AND GEOMETRY

Competency 0009

Apply principles and procedures related to measurement.

The following topics are examples of content that may be covered under this competency.

- Compare and convert measurements within various measurement systems.
- Apply formulas to find measures (e.g., angles, length, perimeter, area, volume) of a variety of two- and three-dimensional figures.
- Apply proportional and spatial reasoning to solve mathematical and real-world problems, including the effect of scale factors.
- Apply knowledge of the Pythagorean theorem to solve mathematical and real-world problems.
- Solve problems involving derived units (e.g., density, pressure, rates of change).

Competency 0010

Apply the principles and properties of Euclidean geometry in two and three dimensions.

The following topics are examples of content that may be covered under this competency.

- Use the properties of lines (e.g., parallel, perpendicular) and angles (e.g., supplementary, vertical) to characterize geometric relationships and solve problems.
- Apply the principles of similarity and congruence to solve problems involving two- and three-dimensional figures.
- Apply the properties of circles (e.g., intersecting chords and secants) and polygons (e.g., number and length of sides, measure of angles) to analyze and solve problems.
- Apply the properties of special right triangles and the sine, cosine, and tangent ratios in right triangles to solve problems.
- Use principles and theorems of geometry to evaluate logical arguments and mathematical conjectures, and to construct and evaluate formal and informal proofs.

Competency 0011

Apply the principles and properties of coordinate and transformational geometries.

The following topics are examples of content that may be covered under this competency.

- Apply geometric concepts (e.g., distance formula, midpoint formula, slope) to model and solve mathematical and real-world problems.
- Apply the geometric concepts of parallel and perpendicular lines to model and solve problems.
- Use two- and three-dimensional coordinate systems to represent and analyze geometric figures.
- Analyze and apply geometric transformations (e.g., translations, reflections, dilations, rotations).
- Use techniques of coordinate geometry to evaluate logical arguments and mathematical conjectures, and to construct and evaluate formal and informal proofs.

SUBAREA IV—PROBABILITY, STATISTICS, AND DISCRETE MATHEMATICS

Competency 0012

Apply the principles, properties, and techniques of probability.

The following topics are examples of content that may be covered under this competency.

- Demonstrate knowledge of probability events and their characteristics (e.g., conditional, independent, mutually exclusive).
- Solve problems using the techniques of probability (e.g., addition and multiplication rules, sample spaces).
- Use and interpret graphic representations of probabilities (e.g., tables, Venn diagrams, tree diagrams, frequency graphs, the normal curve).
- Analyze and apply the properties of normal probability distributions to model and solve problems.
- Apply knowledge of connections between mathematical concepts in different fields (e.g., algebra, geometry, probability) and be able to apply mathematics in real-world contexts.

Competency 0013

Apply the principles, properties, and techniques of statistics.

The following topics are examples of content that may be covered under this competency.

- Apply random sampling techniques to collect representative data.
- Interpret data in a variety of graphic formats (e.g., circle graphs, box-and-whisker plots, scatter plots, normal distributions).
- Apply knowledge of measures of central tendency (mean, median, and mode) and variation (e.g., standard deviation, range).
- Evaluate statistical claims and inferences, and make predictions that are based on a set of data (e.g., analyzing sampling techniques, interpreting statistical measures).

Competency 0014

Apply the principles of discrete mathematics.

The following topics are examples of content that may be covered under this competency.

- Apply various counting strategies (e.g., permutations, combinations, factorials) to problem-solving situations.
- Analyze recurrence relations (e.g., Fibonacci sequence, triangular numbers) and use them to model and solve problems in mathematics and other disciplines.
- Apply the basic elements of discrete mathematics (e.g., finite graphs, trees) to model real-world problems.
- Identify potential applications of discrete mathematics (e.g., set theory, graph theory) across the curriculum.
- Apply basic knowledge of matrices and their operations.

SUBAREA V—PEDAGOGICAL CONTENT KNOWLEDGE

Competency 0015

Analyze a lesson plan for a given content standard in the Oklahoma Academic Standards for Mathematics, including examples of student work and/or assessments, and describe subsequent activities that address student needs on the basis of your analysis.

The following topics are examples of content that may be covered under this competency.

- Apply knowledge of standards-based learning goals for mathematical content.
- Analyze assessment results of student learning or samples of student work for a particular lesson in mathematics, citing specific evidence from the exhibits that identifies a significant mathematical strength as well as a significant area of need shown by the student or students.
- Describe an appropriate instructional strategy or intervention that would help the student or students improve in the identified area of need. Incorporate one of the Standards for Mathematical Practice in your response.
- Describe how this analysis of assessment data or student work can be used to inform future instruction with respect to this content area and the development and reinforcement of sound mathematical practice.