Chapter 111. Texas Essential Knowledge and Skills for Mathematics

Subchapter A. Elementary

§111.2. Kindergarten, Adopted 2012.

(a)   (No change.)

(b)   Knowledge and skills.

    (1)   (No change.)

    (2)   Number and operations. The student understands [applies mathematical process standards to understand] how to represent and compare whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system. The student is expected to:

        (A)-(I)   (No change.)

    (3)   Number and operations. The student develops [applies mathematical process standards to develop] an understanding of addition and subtraction situations in order to solve problems. The student is expected to:

        (A)-(C)   (No change.)

    (4)   Number and operations. The student identifies [applies mathematical process standards to identify] coins in order to recognize the need for monetary transactions. The student is expected to identify U.S. coins by name, including pennies, nickels, dimes, and quarters.

    (5)   Algebraic reasoning. The student identifies [applies mathematical process standards to identify] the pattern in the number word list. The student is expected to recite numbers up to at least 100 by ones and tens beginning with any given number.

    (6)   Geometry and measurement. The student analyzes [applies mathematical process standards to analyze] attributes of two-dimensional shapes and three-dimensional solids to develop generalizations about their properties. The student is expected to:

        (A)-(F)   (No change.)

    (7)   Geometry and measurement. The student directly compares [applies mathematical process standards to directly compare] measurable attributes. The student is expected to:

        (A)-(B)   (No change.)

    (8)   Data analysis. The student collects and organizes [applies mathematical process standards to collect and organize] data to make it useful for interpreting information. The student is expected to:

        (A)-(C)   (No change.)

    (9)   Personal financial literacy. The student manages [applies mathematical process standards to manage] one's financial resources effectively for lifetime financial security. The student is expected to:

        (A)-(D)   (No change.)

§111.3. Grade 1, Adopted 2012.

(a)   (No change.)

(b)   Knowledge and skills.

    (1)   (No change.)

(2) Number and operations. The student represents and compares [applies mathematical process standards to represent and compare] whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system related to place value. The student is expected to:

  (A)-(G) (No change.)

(3) Number and operations. The student develops and uses [applies mathematical process standards to develop and use] strategies for whole number addition and subtraction computations in order to solve problems. The student is expected to:

  (A)-(F) (No change.)

(4) Number and operations. The student identifies [applies mathematical process standards to identify] coins, their values, and the relationships among them in order to recognize the need for monetary transactions. The student is expected to:

  (A)-(C) (No change.)

(5) Algebraic reasoning. The student identifies and applies [mathematical process standards to identify and apply] number patterns within properties of numbers and operations in order to describe relationships. The student is expected to:

  (A)-(G) (No change.)

(6) Geometry and measurement. The student analyzes [applies mathematical process standards to analyze] attributes of two-dimensional shapes and three-dimensional solids to develop generalizations about their properties. The student is expected to:

  (A)-(H) (No change.)

(7) Geometry and measurement. The student selects and uses [applies mathematical process standards to select and use] units to describe length and time. The student is expected to:

  (A)-(E) (No change.)

(8) Data analysis. The student organizes [applies mathematical process standards to organize] data to make it useful for interpreting information and solving problems. The student is expected to:

  (A)-(C) (No change.)

(9) Personal financial literacy. The student manages [applies mathematical process standards to manage] one's financial resources effectively for lifetime financial security. The student is expected to:

  (A)-(D) (No change.)

§111.4. Grade 2, Adopted 2012.

(a) (No change.)

(b) Knowledge and skills.

(1) (No change.)

(2) Number and operations. The student understands [applies mathematical process standards to understand] how to represent and compare whole numbers, the relative position and magnitude of whole numbers, and relationships within the numeration system related to place value. The student is expected to:

  (A)-(F) (No change.)

(3) Number and operations. The student recognizes and represents [applies mathematical process standards to recognize and represent] fractional units and communicates how they are used to name parts of a whole. The student is expected to:

(A)-(D) (No change.)

(4)   Number and operations. The student underlines develops and uses [~~applies mathematical process standards to develop and use~~] strategies and methods for whole number computations in order to solve addition and subtraction problems with efficiency and accuracy. The student is expected to:

(A)-(D) (No change.)

(5)   Number and operations. The student determines [~~applies mathematical process standards to determine~~] the value of coins in order to solve monetary transactions. The student is expected to:

(A)-(B) (No change.)

(6)   Number and operations. The student connects [~~applies mathematical process standards to connect~~] repeated addition and subtraction to multiplication and division situations that involve equal groupings and shares. The student is expected to:

(A)-(B) (No change.)

(7)   Algebraic reasoning. The student identifies and applies [~~mathematical process standards to identify and apply~~] number patterns within properties of numbers and operations in order to describe relationships. The student is expected to:

(A)-(C) (No change.)

(8)   Geometry and measurement. The student analyzes [~~applies mathematical process standards to analyze~~] attributes of two-dimensional shapes and three-dimensional solids to develop generalizations about their properties. The student is expected to:

(A)-(E) (No change.)

(9)   Geometry and measurement. The student selects and uses [~~applies mathematical process standards to select and use~~] units to describe length, area, and time. The student is expected to:

(A)-(G) (No change.)

(10)   Data analysis. The student organizes [~~applies mathematical process standards to organize~~] data to make it useful for interpreting information and solving problems. The student is expected to:

(A)-(D) (No change.)

(11)   Personal financial literacy. The student manages [~~applies mathematical process standards to manage~~] one's financial resources effectively for lifetime financial security. The student is expected to:

(A)-(F) (No change.)

§111.5. Grade 3, Adopted 2012.

(a)   (No change.)

(b)   Knowledge and skills.

(1)   (No change.)

(2)   Number and operations. The student represents and compares [~~applies mathematical process standards to represent and compare~~] whole numbers and understand relationships related to place value. The student is expected to:

(A)-(D) (No change.)

(3)   Number and operations. The student represents and explains [~~applies mathematical process standards to represent and explain~~] fractional units. The student is expected to:

(A)-(H) (No change.)

(4)   Number and operations. The student develops and uses [applies mathematical process standards to develop and use] strategies and methods for whole number computations in order to solve problems with efficiency and accuracy. The student is expected to:

(A)-(K) (No change.)

(5)   Algebraic reasoning. The student analyzes and creates [applies mathematical process standards to analyze and create] patterns and relationships. The student is expected to:

(A)-(E) (No change.)

(6)   Geometry and measurement. The student analyzes [applies mathematical process standards to analyze] attributes of two-dimensional geometric figures to develop generalizations about their properties. The student is expected to:

(A)-(E) (No change.)

(7)   Geometry and measurement. The student selects [applies mathematical process standards to select] appropriate units, strategies, and tools to solve problems involving customary and metric measurement. The student is expected to:

(A)-(E) (No change.)

(8)   Data analysis. The student solves [applies mathematical process standards to solve] problems by collecting, organizing, displaying, and interpreting data. The student is expected to:

(A)-(B) (No change.)

(9)   Personal financial literacy. The student manages [applies mathematical process standards to manage] one's financial resources effectively for lifetime financial security. The student is expected to:

(A)-(F) (No change.)

§111.6. Grade 4, Adopted 2012.

(a)   (No change.)

(b)   Knowledge and skills.

(1)   (No change.)

(2)   Number and operations. The student represents, compares, and orders [applies mathematical process standards to represent, compare, and order] whole numbers and decimals and understand relationships related to place value. The student is expected to:

(A)-(H) (No change.)

(3)   Number and operations. The student represents and generates [applies mathematical process standards to represent and generate] fractions to solve problems. The student is expected to:

(A)-(G) (No change.)

(4)   Number and operations. The student develops and uses [applies mathematical process standards to develop and use] strategies and methods for whole number computations and decimal sums and differences in order to solve problems with efficiency and accuracy. The student is expected to:

(A)-(H) (No change.)

(5)   Algebraic reasoning. The student develops [applies mathematical process standards to develop] concepts of expressions and equations. The student is expected to:

(A)-(D) (No change.)

(6)   Geometry and measurement. The student analyzes [applies mathematical process standards to analyze] geometric attributes in order to develop generalizations about their properties. The student is expected to:

(A)-(D) (No change.)

(7)   Geometry and measurement. The student <u>solves</u> [~~applies mathematical process standards to solve~~] problems involving angles less than or equal to 180 degrees. The student is expected to:

(A)-(E) (No change.)

(8)   Geometry and measurement. The student <u>selects</u> [~~applies mathematical process standards to select~~] appropriate customary and metric units, strategies, and tools to solve problems involving measurement. The student is expected to:

(A)-(C) (No change.)

(9)   Data analysis. The student <u>solves</u> [~~applies mathematical process standards to solve~~] problems by collecting, organizing, displaying, and interpreting data. The student is expected to:

(A)-(B) (No change.)

(10)   Personal financial literacy. The student <u>manages</u> [~~applies mathematical process standards to manage~~] one's financial resources effectively for lifetime financial security. The student is expected to:

(A)-(E) (No change.)

§111.7. Grade 5, Adopted 2012.

(a)   (No change.)

(b)   Knowledge and skills.

(1)   (No change.)

(2)   Number and operations. The student <u>represents, compares, and orders</u> [~~applies mathematical process standards to represent, compare, and order~~] positive rational numbers and understand relationships as related to place value. The student is expected to:

(A)-(C) (No change.)

(3)   Number and operations. The student <u>develops and uses</u> [~~applies mathematical process standards to develop and use~~] strategies and methods for positive rational number computations in order to solve problems with efficiency and accuracy. The student is expected to:

(A)-(L) (No change.)

(4)   Algebraic reasoning. The student <u>develops</u> [~~applies mathematical process standards to develop~~] concepts of expressions and equations. The student is expected to:

(A)-(H) (No change.)

(5)   Geometry and measurement. The student <u>classifies</u> [~~applies mathematical process standards to classify~~] two-dimensional figures by attributes and properties. The student is expected to classify two-dimensional figures in a hierarchy of sets and subsets using graphic organizers based on their attributes and properties.

(6)   Geometry and measurement. The student <u>understands, recognizes, and quantifies</u> [~~applies mathematical process standards to understand, recognize, and quantify~~] volume. The student is expected to:

(A)-(B) (No change.)

(7)   Geometry and measurement. The student <u>selects</u> [~~applies mathematical process standards to select~~] appropriate units, strategies, and tools to solve problems involving measurement. The student is expected to solve problems by calculating conversions within a measurement system, customary or metric.

(8)   Geometry and measurement. The student <u>identifies</u> [~~applies mathematical process standards to identify~~] locations on a coordinate plane. The student is expected to:

       (A)-(C) (No change.)

(9)   Data analysis. The student <u>solves</u> [~~applies mathematical process standards to solve~~] problems by collecting, organizing, displaying, and interpreting data. The student is expected to:

       (A)-(C) (No change.)

(10)   Personal financial literacy. The student <u>manages</u> [~~applies mathematical process standards to manage~~] one's financial resources effectively for lifetime financial security. The student is expected to:

       (A)-(F) (No change.)

Subchapter B. Middle School

§111.26. Grade 6, Adopted 2012.

(a)   (No change.)

(b)   Knowledge and skills.

    (1)   (No change.)

    (2)   Number and operations. The student <u>represents and uses</u> [~~applies mathematical process standards to represent and use~~] rational numbers in a variety of forms. The student is expected to:

        (A)-(E)   (No change.)

    (3)   Number and operations. The student <u>represents</u> [~~applies mathematical process standards to represent~~] addition, subtraction, multiplication, and division while solving problems and justifying solutions. The student is expected to:

        (A)-(E)   (No change.)

    (4)   Proportionality. The student <u>develops</u> [~~applies mathematical process standards to develop~~] an understanding of proportional relationships in problem situations. The student is expected to:

        (A)-(H)   (No change.)

    (5)   Proportionality. The student <u>solves</u> [~~applies mathematical process standards to solve~~] problems involving proportional relationships. The student is expected to:

        (A)-(C)   (No change.)

    (6)   Expressions, equations, and relationships. The student <u>uses</u> [~~applies mathematical process standards to use~~] multiple representations to describe algebraic relationships. The student is expected to:

        (A)-(C)   (No change.)

    (7)   Expressions, equations, and relationships. The student <u>develops</u> [~~applies mathematical process standards to develop~~] concepts of expressions and equations. The student is expected to:

        (A)-(D)   (No change.)

    (8)   Expressions, equations, and relationships. The student <u>uses</u> [~~applies mathematical process standards to use~~] geometry to represent relationships and solve problems. The student is expected to:

        (A)-(D)   (No change.)

    (9)   Expressions, equations, and relationships. The student <u>uses</u> [~~applies mathematical process standards to use~~] equations and inequalities to represent situations. The student is expected to:

        (A)-(C)   (No change.)

    (10)   Expressions, equations, and relationships. The student <u>uses</u> [~~applies mathematical process standards to use~~] equations and inequalities to solve problems. The student is expected to:

        (A)-(B)   (No change.)

    (11)   Measurement and data. The student <u>uses</u> [~~applies mathematical process standards to use~~] coordinate geometry to identify locations on a plane. The student is expected to graph points in all four quadrants using ordered pairs of rational numbers.

    (12)   Measurement and data. The student <u>uses</u> [~~applies mathematical process standards to use~~] numerical or graphical representations to analyze problems. The student is expected to:

        (A)-(D)   (No change.)

(13)   Measurement and data. The student uses [applies mathematical process standards to use] numerical or graphical representations to solve problems. The student is expected to:

        (A)-(B) (No change.)

(14)   Personal financial literacy. The student develops [applies mathematical process standards to develop] an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

        (A)-(H) (No change.)

§111.27. Grade 7, Adopted 2012.

(a)   (No change.)

(b)   Knowledge and skills.

    (1)   (No change.)

    (2)   Number and operations. The student represents and uses [applies mathematical process standards to represent and use] rational numbers in a variety of forms. The student is expected to extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of rational numbers.

    (3)   Number and operations. The student adds, subtracts, multiplies, and divides [applies mathematical process standards to add, subtract, multiply, and divide] while solving problems and justifying solutions. The student is expected to:

        (A)-(B) (No change.)

    (4)   Proportionality. The student represents and solves [applies mathematical process standards to represent and solve] problems involving proportional relationships. The student is expected to:

        (A)-(E) (No change.)

    (5)   Proportionality. The student uses [applies mathematical process standards to use] geometry to describe or solve problems involving proportional relationships. The student is expected to:

        (A)-(C) (No change.)

    (6)   Proportionality. The student uses [applies mathematical process standards to use] probability and statistics to describe or solve problems involving proportional relationships. The student is expected to:

        (A)-(I)   (No change.)

    (7)   Expressions, equations, and relationships. The student represents [applies mathematical process standards to represent] linear relationships using multiple representations. The student is expected to represent linear relationships using verbal descriptions, tables, graphs, and equations that simplify to the form $y = mx + b$.

    (8)   Expressions, equations, and relationships. The student develops [applies mathematical process standards to develop] geometric relationships with volume. The student is expected to:

        (A)-(C) (No change.)

    (9)   Expressions, equations, and relationships. The student solves [applies mathematical process standards to solve] geometric problems. The student is expected to:

        (A)-(D) (No change.)

    (10)   Expressions, equations, and relationships. The student uses [applies mathematical process standards to use] one-variable equations and inequalities to represent situations. The student is expected to:

        (A)-(C) (No change.)

(11) Expressions, equations, and relationships. The student solves [~~applies mathematical process standards to solve~~] one-variable equations and inequalities. The student is expected to:

(A)-(C) (No change.)

(12) Measurement and data. The student uses [~~applies mathematical process standards to use~~] statistical representations to analyze data. The student is expected to:

(A)-(C) (No change.)

(13) Personal financial literacy. The student develops [~~applies mathematical process standards to develop~~] an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

(A)-(F) (No change.)

§111.28. Grade 8, Adopted 2012.

(a) (No change.)

(b) Knowledge and skills.

(1) (No change.)

(2) Number and operations. The student represents and uses [~~applies mathematical process standards to represent and use~~] real numbers in a variety of forms. The student is expected to:

(A)-(D) (No change.)

(3) Proportionality. The student uses [~~applies mathematical process standards to use~~] proportional relationships to describe dilations. The student is expected to:

(A)-(C) (No change.)

(4) Proportionality. The student explains [~~applies mathematical process standards to explain~~] proportional and non-proportional relationships involving slope. The student is expected to:

(A)-(C) (No change.)

(5) Proportionality. The student uses [~~applies mathematical process standards to use~~] proportional and non-proportional relationships to develop foundational concepts of functions. The student is expected to:

(A)-(I) (No change.)

(6) Expressions, equations, and relationships. The student develops [~~applies mathematical process standards to develop~~] mathematical relationships and makes [~~make~~] connections to geometric formulas. The student is expected to:

(A)-(C) (No change.)

(7) Expressions, equations, and relationships. The student uses [~~applies mathematical process standards to use~~] geometry to solve problems. The student is expected to:

(A)-(D) (No change.)

(8) Expressions, equations, and relationships. The student uses [~~applies mathematical process standards to use~~] one-variable equations or inequalities in problem situations. The student is expected to:

(A)-(D) (No change.)

(9) Expressions, equations, and relationships. The student uses [~~applies mathematical process standards to use~~] multiple representations to develop foundational concepts of simultaneous linear equations. The student is expected to identify and verify the values of x and y that simultaneously satisfy two linear equations in the form $y = mx + b$ from the intersections of the graphed equations.

(10)   Two-dimensional shapes. The student develops [applies mathematical process standards to develop] transformational geometry concepts. The student is expected to:

(A)-(D) (No change.)

(11)   Measurement and data. The student uses [applies mathematical process standards to use] statistical procedures to describe data. The student is expected to:

(A)-(C) (No change.)

(12)   Personal financial literacy. The student develops [applies mathematical process standards to develop] an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:

(A)-(G) (No change.)

Subchapter C. High School

§111.39. Algebra I, Adopted 2012 (One Credit).

(a)-(b)   (No change.)

(c)   Knowledge and skills.

    (1)   (No change.)

    (2)   Linear functions, equations, and inequalities. The student uses [applies the mathematical process standards when using] properties of linear functions to write and represent in multiple ways, with and without technology, linear equations, inequalities, and systems of equations. The student is expected to:

        (A)-(I)   (No change.)

    (3)   Linear functions, equations, and inequalities. The student uses [applies the mathematical process standards when using] graphs of linear functions, key features, and related transformations to represent in multiple ways and solve, with and without technology, equations, inequalities, and systems of equations. The student is expected to:

        (A)-(H)   (No change.)

    (4)   Linear functions, equations, and inequalities. The student formulates [applies the mathematical process standards to formulate] statistical relationships and evaluates [evaluate] their reasonableness based on real-world data. The student is expected to:

        (A)-(C)   (No change.)

    (5)   Linear functions, equations, and inequalities. The student solves [applies the mathematical process standards to solve] , with and without technology, linear equations and evaluates [evaluate] the reasonableness of their solutions. The student is expected to:

        (A)-(C)   (No change.)

    (6)   Quadratic functions and equations. The student uses [applies the mathematical process standards when using] properties of quadratic functions to write and represent in multiple ways, with and without technology, quadratic equations. The student is expected to:

        (A)-(C)   (No change.)

    (7)   Quadratic functions and equations. The student uses [applies the mathematical process standards when using] graphs of quadratic functions and their related transformations to represent in multiple ways and determine, with and without technology, the solutions to equations. The student is expected to:

        (A)-(C)   (No change.)

    (8)   Quadratic functions and equations. The student solves [applies the mathematical process standards to solve] , with and without technology, quadratic equations and evaluates [evaluate] the reasonableness of his or her [their] solutions. The student formulates statistical relationships and evaluates their reasonableness based on real-world data. The student is expected to:

        (A)-(B)   (No change.)

    (9)   Exponential functions and equations. The student uses [applies the mathematical process standards when using] properties of exponential functions and their related transformations to write, graph, and represent in multiple ways exponential equations and evaluates [evaluate] , with and without technology, the reasonableness of his or her [their] solutions. The student formulates statistical relationships and evaluates their reasonableness based on real-world data. The student is expected to:

        (A)-(E)   (No change.)

(10)   Number and algebraic methods. The student applies [the mathematical process standards and] algebraic methods to rewrite in equivalent forms and perform operations on polynomial expressions. The student is expected to:

(A)-(F)   (No change.)

(11)   Number and algebraic methods. The student applies [the mathematical process standards and] algebraic methods to rewrite algebraic expressions into equivalent forms. The student is expected to:

(A)-(B)   (No change.)

(12)   Number and algebraic methods. The student applies [the mathematical process standards and] algebraic methods to write, solve, analyze, and evaluate equations, relations, and functions. The student is expected to:

(A)-(E)   (No change.)

§111.40. Algebra II, Adopted 2012 (One-Half to One Credit).

(a)-(b)   (No change.)

(c)   Knowledge and skills.

(1)   (No change.)

(2)   Attributes of functions and their inverses. The student understands [applies mathematical processes to understand] that functions have distinct key attributes and understands [understand] the relationship between a function and its inverse. The student is expected to:

(A)-(D)   (No change.)

(3)   Systems of equations and inequalities. The student formulates [applies mathematical processes to formulate] systems of equations and inequalities, uses [use] a variety of methods to solve, and analyzes [analyze] reasonableness of solutions. The student is expected to:

(A)-(G)   (No change.)

(4)   Quadratic and square root functions, equations, and inequalities. The student understands [applies mathematical processes to understand] that quadratic and square root functions, equations, and quadratic inequalities can be used to model situations, solve problems, and make predictions. The student is expected to:

(A)-(H)   (No change.)

(5)   Exponential and logarithmic functions and equations. The student understands [applies mathematical processes to understand] that exponential and logarithmic functions can be used to model situations and solve problems. The student is expected to:

(A)-(E)   (No change.)

(6)   Cubic, cube root, absolute value and rational functions, equations, and inequalities. The student understands [applies mathematical processes to understand] that cubic, cube root, absolute value and rational functions, equations, and inequalities can be used to model situations, solve problems, and make predictions. The student is expected to:

(A)-(L)   (No change.)

(7)   Number and algebraic methods. The student simplifies and performs [applies mathematical processes to simplify and perform] operations on expressions and solves [to solve] equations. The student is expected to:

(A)-(I)   (No change.)

(8)   Data. The student <u>analyzes</u> [~~applies mathematical processes to analyze~~] data, <u>selects</u> [~~select~~] appropriate models, <u>writes</u> [~~write~~] corresponding functions, and <u>makes</u> [~~make~~] predictions. The student is expected to:

(A)-(C) (No change.)

§111.41. Geometry, Adopted 2012 (One Credit).

(a)-(b)   (No change.)

(c)   Knowledge and skills.

(1)   (No change.)

(2)   Coordinate and transformational geometry. The student <u>understands</u> [~~uses the process skills to understand~~] the connections between algebra and geometry and uses the one- and two-dimensional coordinate systems to verify geometric conjectures. The student is expected to:

(A)-(C) (No change.)

(3)   Coordinate and transformational geometry. The student <u>generates and describes</u> [~~uses the process skills to generate and describe~~] rigid transformations (translation, reflection, and rotation) and non-rigid transformations (dilations that preserve similarity and reductions and enlargements that do not preserve similarity). The student is expected to:

(A)-(D) (No change.)

(4)   Logical argument and constructions. The student uses [~~the process skills with~~] deductive reasoning to understand geometric relationships. The student is expected to:

(A)-(D) (No change.)

(5)   (No change.)

(A)-(D) (No change.)

(6)   Proof and congruence. The student uses [~~the process skills with~~] deductive reasoning to prove and apply theorems by using a variety of methods such as coordinate, transformational, and axiomatic and formats such as two-column, paragraph, and flow chart. The student is expected to:

(A)-(E) (No change.)

(7)   Similarity, proof, and trigonometry. The student <u>applies</u> [~~uses the process skills in applying~~] similarity to solve problems. The student is expected to:

(A)-(B) (No change.)

(8)   Similarity, proof, and trigonometry. The student uses [~~the process skills with~~] deductive reasoning to prove and apply theorems by using a variety of methods such as coordinate, transformational, and axiomatic and formats such as two-column, paragraph, and flow chart. The student is expected to:

(A)-(B) (No change.)

(9)   Similarity, proof, and trigonometry. The student <u>understands</u> [~~uses the process skills to understand~~] and <u>applies</u> [~~apply~~] relationships in right triangles. The student is expected to:

(A)-(B) (No change.)

(10)   Two-dimensional and three-dimensional figures. The student <u>recognizes</u> [~~uses the process skills to recognize~~] characteristics and dimensional changes of two- and three-dimensional figures. The student is expected to:

(A)-(B) (No change.)

(11)   Two-dimensional and three-dimensional figures. The student applies [uses the process skills in the application of] formulas to determine measures of two- and three-dimensional figures. The student is expected to:

(A)-(D) (No change.)

(12)   Circles. The student understands [uses the process skills to understand] geometric relationships and applies [apply] theorems and equations about circles. The student is expected to:

(A)-(E) (No change.)

(13)   Probability. The student understands [uses the process skills to understand] probability in real-world situations and how to apply independence and dependence of events. The student is expected to:

(A)-(E) (No change.)

§111.42. Precalculus, Adopted 2012 (One-Half to One Credit).

(a)-(b) (No change.)

(c)   Knowledge and skills.

(1)   (No change.)

(2)   Functions. The student explores, describes, and analyzes [uses process standards in mathematics to explore, describe, and analyze] the attributes of functions. The student makes connections between multiple representations of functions and algebraically constructs new functions. The student analyzes and uses functions to model real-world problems. The student is expected to:

(A)-(P) (No change.)

(3)   Relations and geometric reasoning. The student models [uses the process standards in mathematics to model] and makes [make] connections between algebraic and geometric relations. The student is expected to:

(A)-(I) (No change.)

(4)   Number and measure. The student applies [uses process standards in mathematics to apply] appropriate techniques, tools, and formulas to calculate measures in mathematical and real-world problems. The student is expected to:

(A)-(K) (No change.)

(5)   Algebraic reasoning. The student evaluates [uses process standards in mathematics to evaluate] expressions, describes [describe] patterns, formulates [formulate] models, and solves [solve] equations and inequalities using properties, procedures, or algorithms. The student is expected to:

(A)-(N) (No change.)

§111.43. Mathematical Models with Applications, Adopted 2012 (One Credit).

(a)-(b) (No change.)

(c)   Knowledge and skills.

(1)   (No change.)

(2)   Mathematical modeling in personal finance. The student uses [mathematical processes with] graphical and numerical techniques to study patterns and analyze data related to personal finance. The student is expected to:

(A)-(C) (No change.)

(3)   Mathematical modeling in personal finance. The student uses [~~mathematical processes with~~] algebraic formulas, graphs, and amortization modeling to solve problems involving credit. The student is expected to:

     (A)-(D) (No change.)

(4)   Mathematical modeling in personal finance. The student uses [~~mathematical processes with~~] algebraic formulas, numerical techniques, and graphs to solve problems related to financial planning. The student is expected to:

     (A)-(C) (No change.)

(5)   Mathematical modeling in science and engineering. The student applies [~~mathematical processes with~~] algebraic techniques to study patterns and analyze data as it applies to science. The student is expected to:

     (A)-(C) (No change.)

(6)   Mathematical modeling in science and engineering. The student applies [~~mathematical processes with~~] algebra and geometry to study patterns and analyze data as it applies to architecture and engineering. The student is expected to:

     (A)-(D) (No change.)

(7)   Mathematical modeling in fine arts. The student uses [~~mathematical processes with~~] algebra and geometry to study patterns and analyze data as it applies to fine arts. The student is expected to:

     (A)-(D) (No change.)

(8)   Mathematical modeling in social sciences. The student determines [~~applies mathematical processes to determine~~] the number of elements in a finite sample space and compute the probability of an event. The student is expected to:

     (A)-(C) (No change.)

(9)   Mathematical modeling in social sciences. The student applies [~~mathematical processes and~~] mathematical models to analyze data as it applies to social sciences. The student is expected to:

     (A)-(F) (No change.)

(10)   Mathematical modeling in social sciences. The student designs [~~applies mathematical processes to design~~] a study and uses [~~use~~] graphical, numerical, and analytical techniques to communicate the results of the study. The student is expected to:

     (A)-(B) (No change.)

§111.44. Advanced Quantitative Reasoning, Adopted 2012 (One-Half to One Credit).

(a)-(b) (No change.)

(c)   Knowledge and skills.

     (1)   (No change.)

     (2)   Numeric reasoning. The student generates [~~applies the process standards in mathematics to generate~~] new understandings by extending existing knowledge. The student generates new mathematical understandings through problems involving numerical data that arise in everyday life, society, and the workplace. The student extends existing knowledge and skills to analyze real-world situations. The student is expected to:

          (A)-(H) (No change.)

     (3)   Algebraic reasoning (expressions, equations, and generalized relationships). The student creates [~~applies the process standards in mathematics to create~~] and analyzes [~~analyze~~] mathematical models of everyday situations to make informed decisions related to earning, investing, spending, and borrowing money by appropriate, proficient, and efficient use of tools, including technology.

The student uses mathematical relationships to make connections and predictions. The student judges the validity of a prediction and uses mathematical models to represent, analyze, and solve dynamic real-world problems. The student is expected to:

(A)-(H) (No change.)

(4)   Probabilistic and statistical reasoning. The student generates [uses the process standards in mathematics to generate] new understandings of probability and statistics. The student analyzes statistical information and evaluates risk and return to connect mathematical ideas and make informed decisions. The student applies a problem-solving model and statistical methods to design and conduct a study that addresses one or more particular question(s). The student uses multiple representations to communicate effectively the results of student-generated statistical studies and the critical analysis of published statistical studies. The student is expected to:

(A)-(T) (No change.)

§111.47. Statistics, Adopted 2015 (One Credit).

(a)-(b)   (No change.)

(c)   Knowledge and skills.

(1)   (No change.)

(2)   Statistical process sampling and experimentation. The student applies [mathematical processes to apply] understandings about statistical studies, surveys, and experiments to design and conduct a study and uses [use] graphical, numerical, and analytical techniques to communicate the results of the study. The student is expected to:

(A)-(G) (No change.)

(3)   Variability. The student describes and models [applies the mathematical process standards when describing and modeling] variability. The student is expected to:

(A)-(D) (No change.)

(4)   Categorical and quantitative data. The student represents and analyzes [applies the mathematical process standards to represent and analyze] both categorical and quantitative data. The student is expected to:

(A)-(F) (No change.)

(5)   Probability and random variables. The student connects [applies the mathematical process standards to connect] probability and statistics. The student is expected to:

(A)-(D) (No change.)

(6)   Inference. The student makes [applies the mathematical process standards to make] inferences and justifies [justify] conclusions from statistical studies. The student is expected to:

(A)-(J) (No change.)

(7)   Bivariate data. The student analyzes [applies the mathematical process standards to analyze] relationships among bivariate quantitative data. The student is expected to:

(A)-(F) (No change.)

§111.48. Algebraic Reasoning, Adopted 2015 (One Credit).

(a)-(b)   (No change.)

(c)   Knowledge and skills.

(1)   (No change.)

(2)   Patterns and structure. The student <u>connects</u> [~~applies mathematical processes to connect~~] finite differences or common ratios to attributes of functions. The student is expected to:

(A)-(D) (No change.)

(3)   Patterns and structure. The student <u>understands</u> [~~applies mathematical processes to understand~~] the connections among representations of functions and combinations of functions, including the constant function, $f(x) = x$, $f(x) = x^2$, $f(x) = \sqrt{x}$, $f(x) = {}^1/_x$, $f(x) = x^3$, $f(x) = \sqrt[3]{x}$, $f(x) = b^x$, $f(x) = |x|$, and $f(x) = \log_b (x)$ where b is 10 or e; functions and their inverses; and key attributes of these functions. The student is expected to:

(A)-(F) (No change.)

(4)   Number and algebraic methods. The student <u>simplifies and performs</u> [~~applies mathematical processes to simplify and perform~~] operations on functions represented in a variety of ways, including real-world situations. The student is expected to:

(A)-(D) (No change.)

(5)   Number and algebraic methods. The student <u>represents, simplifies, and performs</u> [~~applies mathematical processes to represent, simplify, and perform~~] operations on matrices and <u>solves</u> [~~to solve~~] systems of equations using matrices. The student is expected to:

(A)-(E) (No change.)

(6)   Number and algebraic methods. The student <u>estimates and determines</u> [~~applies mathematical processes to estimate and determine~~] solutions to equations resulting from functions and real-world applications with fluency. The student is expected to:

(A)-(C) (No change.)

(7)   Modeling from data. The student <u>analyzes and models</u> [~~applies mathematical processes to analyze and model~~] data based on real-world situations with corresponding functions. The student is expected to:

(A)-(E) (No change.)