NUMBER SENSE AND OPERATIONS STRAND

A2.N.1 Evaluate numerical expressions with negative and/or fractional exponents, without the aid of a calculator (when the answers are rational numbers).

Addressed in U4L9, U4L10, U10L2, U10L5

A2.N.2 Perform arithmetic operations (addition, subtraction, multiplication, division) with expressions containing irrational numbers in radical form.

Addressed in U4L3 to U4L7. At eMathInstruction, we believe that this type of manipulation is outdated, but have included it to satisfy state standards.

A2.N.3 Perform arithmetic operations with polynomial expressions containing rational coefficients

Addressed in U3L2, U6L2

A2.N.4 Perform arithmetic operations on irrational expressions

Addressed in U4L3 to U4L7. It is hard to discern how this standard is markedly different from A2.N.2.

A2.N.5 Rationalize a denominator containing a radical expression

Addressed in U4L4.

A2.N.6 Write square roots of negative numbers in terms of *i.*

Addressed in U5L1 and various other lessons, especially those where the quadratic formula is used to solve quadratic equations with complex solutions (U5L4).

A2.N.7 Simplify powers of *i.*

Addressed in U5L1.

A2.N.8 Determine the conjugate of a complex number.

Addressed in U5L3.

A2.N.9 Perform arithmetic operations on complex numbers and write the answer in the form $a+bi$ *Note: This includes simplifying expressions with complex denominators.*

Addressed in U5L2 and U5L3.

A2.N.10 Know and apply sigma notation

Addressed in U12L1 and the entirety of Unit #13.

ALGEBRA STRAND

A2.A.1 Solve absolute value equations and inequalities involving linear expressions in one variable.

Addressed in U3L16 and U3L17.

A2.A.2 Use the discriminant to determine the nature of the roots of a quadratic equation.

Addressed in U5L4 and U5L5.

A2.A.3 Solve systems of equations involving one linear equation and one quadratic equation algebraically *Note: This includes rational equations that result in linear equations with extraneous roots.*

Addressed in U3L7, U4L7, and U6L9. Please note that at eMathInstruction, we do not understand how a system comprised of one linear and one quadratic equation can result in rational equations, but we have included rational equation work with extraneous roots.

A2.A.4 Solve quadratic inequalities in one and two variables, algebraically and graphically.

Addressed in U3L9 and U3L10.

A2.A.5 Use direct and inverse variation to solve for unknown values.

Addressed in U2L1 (direct) and U6L4 (indirect).

A2.A.6 Solve an application which results in an exponential function.

Addressed in U6L3, U6L4, U6L9, U13L4.

A2.A.7 Factor polynomial expressions completely, using any combination of the following techniques: common factor extraction, difference of two perfect squares, quadratic trinomials.

Addressed in U3L3, U3L7, U6L1, U6L2 and periodically throughout the rest of the text when factoring is necessary.

A2.A.8 Apply the rules of exponents to simplify expressions involving negative and/or fractional exponents.

Addressed in U4L9 and U10L1. Please note, the problems addressed are primarily numerical. A separate lesson containing problems with variable manipulation will be added to Version 2.0 and released online in the Fall of 2009.

A2.A.9 Rewrite algebraic expressions that contain negative exponents using only positive exponents.

Addressed in U10L1. Again, please read the note for A2.A.8.

A2.A.10 Rewrite algebraic expressions with fractional exponents as radical expressions.

Addressed in U4L9. Read note for A2.A.8.

A2.A.11 Rewrite algebraic expressions in radical form as expressions with fractional exponents.

Addressed in U4L9. Read note for A2.A.8.

A2.A.12 Evaluate exponential expressions, including those with base e.

Addressed in U10L1, U10L3, U10L4, U10L10, and U10L11.

A2.A.13 Simplify radical expressions.

Addressed in U4L3. Read note for A2.A.8.

A2.A.14 Perform addition, subtraction, multiplication, and division of radical expressions.

Addressed in U4L3 and U4L4. Read note for A2.A.8.

A2.A.15 Rationalize denominators involving algebraic radical expressions.

Addressed in U4L4. Read note for A2.A.8.

A2.A.16 Perform arithmetic operations with rational expressions and rename to lowest terms.

Addressed in U6L5 to U6L7.

A2.A.17 Simplify complex fractional expressions.

Addressed in U6L8.

A2.A.18 Evaluate logarithmic expressions in any base.

Addressed in U10L5, U10L6, U10L10.

A2.A.19 Apply the properties of logarithms to rewrite logarithmic expressions in equivalent forms

Addressed in U10L7, U10L8, U10L10.

A2.A.20 Determine the sum and product of the roots of a quadratic equation by examining its coefficients.

Addressed in U4L8.

A2.A.21 Determine the quadratic equation, given the sum and product of its roots.

Addressed in U4L8.

A2.A.22 Solve radical equations.

Addressed in U4L2.

A2.A.23 Solve rational equations and **inequalities**.

Addressed in U6L9. NOTE – Rational inequalities are NOT addressed in the e-text. We feel that this topic, to be developed thoroughly, necessitates a discussion and then understanding of rational function graphs, including the topics of vertical asymptotes and singularities in rational expressions. Thus, this topic, if necessary at all, should be reserved for precalculus courses. We invite users of the e-text to join the discussion of this topic.

A2.A.24 Know and apply the technique of completing the square.

Addressed in U3L12, U3L15, U4L5.

A2.A.25 Solve quadratic equations, using the quadratic formula.

Addressed in U4L6, U4L7, U5L4, U5L5.

A2.A.26 Find the solution to polynomial equations of higher degree that can be solved using factoring and/or the quadratic formula.

Addressed in U6L1 and U6L2.

A2.A.27 Solve exponential equations with and without common bases.

Addressed in U10L2 to U10L4, U10L9, and U10L10.

A2.A.28 Solve a logarithmic equation by rewriting as an exponential equation.

Addressed in U10L8.

A2.A.29 Identify an arithmetic or geometric sequence and find the formula for its *n*th term.

Addressed in U13L2.

A2.A.30 Determine the common difference in an arithmetic sequence.

Addressed in U13L2.

A2.A.31 Determine the common ratio in a geometric sequence.

Addressed in U13L2.

A2.A.32 Determine a specified term of an arithmetic or geometric sequence.

Addressed in U13L2.

A2.A.33 Specify terms of a sequence, given its recursive definition.

Addressed in each lesson of Unit #13.

A2.A.34 Represent the sum of a series, using sigma notation.

Addressed in U12L1.

A2.A.35 Determine the sum of the first *n* terms of an arithmetic or geometric series.

Addressed in U13L3 and U13L4.

A2.A.36 Apply the binomial theorem to expand a binomial and determine a specific term of a binomial expansion.

Addressed in U11L8.

A2.A.37 Define a relation and function.

Addressed in U1L1, U2L1 and throughout the e-text.

A2.A.38 Determine when a relation is a function.

Addressed in U1L1 and elsewhere periodically.

A2.A.39 Determine the domain and range of a function from its equation.

Addressed in U1L4, U4L1, U6L3, and U10L6. Please note, there is much more emphasis in this text on determining domain from the equation, rather than range. Range is much more of a topic for calculus than for a course such as this.

A2.A.40 Write functions in functional notation.

Addressed first in U1L2 and throughout the e-text.

A2.A.41 Use functional notation to evaluate functions for given values in the domain.

Addressed first in U1L2 and throughout the e-text.

A2.A.42 Find the composition of functions.

Addressed in U1L3 and periodically throughout the e-text.

A2.A.43 Determine if a function is one-to-one, **onto**, or both.

Addressed in U1L5, U1L6, U8L1, U10L5. NOTE – The topic of onto mappings from one set to another set is entirely omitted from the e-text. Through our own background and extensive research, the only application of the topic of onto mappings that we can find lies in abstract algebra and establishing that two sets have the same size or cardinality. Students struggle enough at this level with the ideas of domain, range, one-to-one functions, and inverses. There is simply no reason for any student to study this topic at the high school level. As a contrast, the topic of one-to-one functions has been woven into the e-text repeatedly because of its importance to inverting functions.

A2.A.44 Define the inverse of a function.

Addressed in U1L6, U6L3, U8L1, and U10L5.

A2.A.45 Determine the inverse of a function and use composition to justify the result.

Addressed in U1L6 and U2L6.

A2.A.46 Perform transformations with functions and relations: $f(x+a)$, $f(x)+a$, $f(-x)$, $-f(x)$, $af(x)$.

Addressed in U3L12, U3L14, U3L13 and various other lessons where geometric transformations (especially shifting) of functions is relevant.

A2.A.47 Determine the center-radius form for the equation of a circle in standard form.

Addressed in U3L15.

A2.A.48 Write the equation of a circle, given its center and a point on the circle.

NOTE – This very specific type of circle problem was not addressed in the e-text. We plan to include it in Version 2.0 and the unit review for Unit #3.

A2.A.49 Write the equation of a circle from its graph.

Addressed in U3L15.

A2.A.50 Approximate the solution to polynomial equations of higher degree by inspecting the graph.

Addressed in U1L2, U6L1 and U6L2.

A2.A.51 Determine the domain and range of a function from its graph.

Addressed in U1L4 and various other lessons throughout the e-text.

A2.A.52 Identify relations and functions, using graphs.

Addressed in U10L1.

A2.A.53 Graph exponential functions of the form $y = b^x$ for positive values of *b*, including $b = e$.

Addressed in U10L1, U10L3, U10L4, and U10L10.

A2.A.54 Graph logarithmic functions, using the inverse of the related exponential function.

Addressed in U10L5 and U10L6.

A2.A.55 Express and apply the six trigonometric functions as ratios of the sides of a right triangle.

Addressed in U7L5, U7L10, and U9L1.

A2.A.56 Know the exact and approximate values of the sine, cosine, and tangent of 0º, 30º, 45º, 60º, 90º, 180º, and 270º angles.

Addressed in U7L4, U7L5, and U7L10. NOTE – most work was done with sine and cosine and most was also done with exact versus approximate values.

A2.A.57 Sketch and use the reference angle for angles in standard position.

Addressed in U7L1, U7L2, and U7L5.

A2.A.58 Know and apply the co-function and reciprocal relationships between trigonometric ratios.

Addressed in U7L10. NOTE – the relationships that were applied were primarily those of the reciprocal relationships. We see no reason, other than historical, for learning the co-function relationships.

A2.A.59 Use the reciprocal and co-function relationships to find the value of the secant, cosecant, and cotangent of 0º, 30º, 45º, 60º, 90º, 180º, and 270º angles.

Addressed in U7L10. Please read note for A2.A.58.

A2.A.60 Sketch the unit circle and represent angles in standard position.

Addressed in U7L1, U7L3, and U7L4.

A2.A.61 Determine the length of an arc of a circle, given its radius and the measure of its central angle.

Addressed in U7L2.

A2.A.62 Find the value of trigonometric functions, if given a point on the terminal side of angle θ.

Addressed in U7L4, U7L5 and U7L10.

A2.A.63 Restrict the domain of the sine, cosine, and tangent functions to ensure the existence of an inverse function .

Addressed in U8L1.

A2.A.64 Use inverse functions to find the measure of an angle, given its sine, cosine, or tangent.

Addressed in U8L1 and others involving the solution of trigonometric equations.

A2.A.65 Sketch the graph of the inverses of the sine, cosine, and tangent functions.

Addressed in U8L1.

A2.A.66 Determine the trigonometric functions of any angle, using technology.

Addressed in U7L10 and throughout the trigonometry units.

A2.A.67 Justify the Pythagorean identities.

Addressed in U7L4, U7L5, and U8L4.

A2.A.68 Solve trigonometric equations for all values of the variable from 0º to 360º.

Addressed in U8L2, U8L3, U8L6, and U8L7.

A2.A.69 Determine amplitude, period, frequency, and <u>phase shift</u>, given the graph or equation of a periodic function.

Addressed in U7L6 to U7L9. NOTE – The topic of phase shift was not included in the e-text. Phase shift, as generally agreed upon by physicists, is the term *C* in the equation $y = A\sin\left(Bx - C\right) + D$. **The state standards specifically want to equate the phase shift and the horizontal shift of a trigonometric curve, which they are not unless the frequency of the curve, *B*, is one. We will not include erroneous material in the e-text.**

A2.A.70 Sketch and recognize one cycle of a function of the form $y = A\sin Bx$ or $y = A\cos Bx$.

Addressed in U7L6 and U7L8.

A2.A.71 Sketch and recognize the graphs of the functions $y = \sec(x)$, $y = \csc(x)$, $y = \tan(x)$, and $y = \cot(x)$.

Addressed in U7L11.

A2.A.72 Write the trigonometric function that is represented by a given periodic graph.

Addressed in U7L6 to U7L9. See note for A2.A.69.

A2.A.73 Solve for an unknown side or angle, using the Law of Sines or the Law of Cosines.

Addressed in U9L2 to U9L5.

A2.A.74 Determine the area of a triangle or a parallelogram, given the measure of two sides and the included angle.

Addressed in U9L1 and various other lessons in Unit #9.

A2.A.75 Determine the solution(s) from the SSA situation (ambiguous case).

Addressed in U9L3 and various other lessons in Unit #9.

A2.A.76 Apply the angle sum and difference formulas for trigonometric functions.

Addressed in U8L4.

A2.A.77 Apply the double-angle and half-angle formulas for trigonometric functions.

NOTE – This standard is not addressed in the e-text. As teachers of calculus, we have NEVER seen the applicability of these formulas and feel that including them would take away from more important material.

MEASUREMENT STRAND

A2.M.1 Define radian measure.

Addressed in U7L2.

A2.M.2 Convert between radian and degree measures.

Addressed in U7L2.

STATISTICS AND PROBABILITY STRAND

A2.S.1 Understand the differences among various kinds of studies (e.g., survey, observation, controlled experiment).

Although not directly addressed in the e-text, we believe that the questions in Unit #12 give teachers ample opportunity to discuss the ideas in this standard.

A2.S.2 Determine factors which may affect the outcome of a survey.

See note to A2.S.1.

A2.S.3 Calculate measures of central tendency with group frequency distributions.

Addressed in U12L2.

A2.S.4 Calculate measures of dispersion (range, quartiles, interquartile range, standard deviation, **variance**) for both samples and populations.

Addressed in U12L2 and U12L3. NOTE – Variance is not discussed in the e-text. Although variance is an interesting and important topic for the study of mathematical statistics and continuous probability distributions, it is just another term to be memorized by students at this level. It has no practical application. On the other hand, standard deviation, its square root, is an extremely important measurement of dispersion and hence is emphasized.

A2.S.5 Know and apply the characteristics of the normal distribution.

Addressed in U12L4.

A2.S.6 Determine from a scatter plot whether a linear, logarithmic, exponential, or power regression model is most appropriate .

Addressed in U10L11. Please note, eMathInstruction believes that the type of regression model used depends not only on how the scatter plots appears, but what the specific application is. For example, most population growth models will be exponential.

A2.S.7 Determine the function for the regression model, using appropriate technology, and use the regression function to interpolate and extrapolate from the data.

Addressed in U2L4, U2L5, U4L10, and U10L11.

A2.S.8 Interpret within the linear regression model the value of the correlation coefficient as a measure of the strength of the relationship.

Addressed in U2L5.

A2.S.9 Differentiate between situations requiring permutations and those requiring combinations.

Addressed in U11L3 and U11L4.

A2.S.10 Calculate the number of possible permutations $({}_nP_r)$ of n items taken r at a time.

Addressed in U11L2 and U11L4.

A2.S.11 Calculate the number of possible combinations $({}_nC_r)$ of *n* items taken *r* at a time.

Addressed in U11L3 to U11L5.

A2.S.12 Use permutations, combinations, and the Fundamental Principle of Counting to determine the number of elements in a sample space and a specific subset (event).

Addressed in U11L2 to U11L5.

A2.S.13 Calculate theoretical probabilities, including geometric applications.

Addressed in U11L1 and U11L5 to U11L7.

A2.S.14 Calculate empirical probabilities.

Addressed in U11L1.

A2.S.15 Know and apply the binomial probability formula to events involving the terms *exactly*, *at least*, and *at most*.

Addressed in U11L6 and U11L7.

A2.S.16 Use the normal distribution as an approximation for binomial probabilities.

NOTE – This standard is not addressed in the e-text. This topic gets at the idea that when calculating a binomial probability with many trials (n>30), that the normal distribution can be used to approximate these probabilities. This was an extremely important topic years ago when graphing calculators and computers weren't around to do the arduous task of calculating 50 or so binomial probabilities and then summing them. Now they are, making the topic completely irrelevant. In addition, to be properly developed, this topic would require, we estimate, no fewer than two lessons, including one to discuss the mean and standard deviations of binomial distributions, $\mu = np$ and $\sigma = \sqrt{np(1-p)}$ **respectively, and one to discuss the conditions under which such an approximation is valid. Considering that we are still working with the normal distribution in half standard deviation increments, these types of problems don't make sense.**