AVENTA LEARNING

Alignment Document
State of Kansas and Aventa Learning Pre-Calculus

Pre-Calculus
2005-2007 Benchmark Blueprint

Standards	Topics	Benchmarks	Unit Name	Course Topic Description
1 Number and Computation	**1.1** The student demonstrates number sense for real numbers and algebraic expressions in a variety of situations.	**1.1.1** knows, explains, and uses equivalent representations for real numbers and algebraic expressions including integers, fractions, decimals, percents, ratios; rational number bases with integer exponents; rational numbers written in scientific notation; absolute value; time; and money, e.g., -4/2 = (-2); a to the -2 power x $b^3 = b^3/a^2$.		
		1.1.2 compares and orders real numbers and/or algebraic expressions and explains the relative magnitude between them, e.g., will $(5n)^2$ always, sometimes, or never be larger than 5n? The student might respond with $(5n)^2$ is greater than 5n if $n > 1$ and $(5n)^2$ is smaller than 5 if $0 < n < 1$.		
		1.1.3 knows and explains what happens to the product or quotient when a real number is multiplied or divided by:		
		1.1.3.a a rational number greater than zero and less than one,		
		1.1.3.b a rational number greater than one,		
		1.1.3.c a rational number less than zero.		

	1.2 The student demonstrates an understanding of the real number system; recognizes, applies, and explains their properties, and extends these properties to algebraic expressions.	**1.2.1** explains and illustrates the relationship between the subsets of the real number system [natural (counting) numbers, whole numbers, integers, rational numbers, irrational numbers] using mathematical models, e.g., number lines or Venn diagrams.		
		1.2.2 identifies all the subsets of the real number system [natural (counting) numbers, whole numbers, integers, rational numbers, irrational numbers] to which a given number belongs.		
		1.2.3 names, uses, and describes these properties with the real number system and demonstrates their meaning including the use of concrete objects:		
		1.2.3.a commutative (a + b = b + a and ab = ba), associative [a = (b + c) = (a + b) + c and a(bc) = (ab)c], distributive [a (b + c) = ab + ac], and substitution properties (if a = 2, then 3a = 3 x 2 = 6);		
		1.2.3.b identity properties for addition and multiplication and inverse properties of addition and multiplication (additive identity: a + 0 = a, multiplicative identity: a x 1 = a, additive inverse: +5 + -5 = 0, multiplicative inverse: 8 x 1/8 = 1);		
		1.2.3.c symmetric property of equality (if a = b, then b = a);		
		1.2.3.d addition and multiplication properties of equality (if a = b, then a + c = b + c and if a = b, then ac = bc) and inequalities (if a > b, then a + c > b + c and if a > b, and c > 0 then ac > bc);		
		1.2.3.e zero product property (if ab = 0, then a = 0 and/or b = 0).		

		1.2.4 uses and describes these properties with the real number system:		
		1.2.4.a transitive property (if a = b and b = c, then a = c),		
		1.2.4.b reflexive property (a = a).		
	1.3 The student uses computational estimation with real numbers in a variety of situations.	**1.3.1** estimates real number quantities using various computational methods including mental math, paper and pencil, concrete objects, and/or appropriate technology.		
		1.3.2 uses various estimation strategies and explains how they were used to estimate real number quantities and algebraic expressions.		
		1.3.3 knows and explains why a decimal representation of an irrational number is an approximate value.		
		1.3.4 knows and explains between which two consecutive integers an irrational number lies.		
	1.4 The student models, performs, and explains computation with real numbers and polynomials in a variety of situations	**1.4.1** computes with efficiency and accuracy using various computational methods including mental math, paper and pencil, concrete objects, and appropriate technology.		
		1.4.2 performs and explains these computational procedures:		
		1.4.2.a addition, subtraction, multiplication, and division using the order of operations;		
		1.4.2.b multiplication or division to find:		
		1.4.2.b.i a percent of a number, e.g., What is 0.5% of 10?;		
		1.4.2.b.ii percent of increase and decrease, e.g., a college raises its tuition		

		form $1,320 per year to $1,425 per year. What percent is the change in tuition?		
		1.4.2.b.iii percent one number is of another number, e.g., 89 is what percent of 82?;		
		1.4.2.b.iv a number when a percent of the number is given, e.g., 80 is 32% of what number?;		
		1.4.2.c manipulation of variable quantities within an equation or inequality, e.g., 5x - 3y = 20 could be written as 5x - 20 = 3y or 5x(2x + 3) = 8 could be written as 8/(5x) = 2x + 3;		
		1.4.2.d simplification of radical expressions (without rationalizing denominators) including square roots of perfect square monomials and cube roots of perfect cubic monomials;		
		1.4.2.e simplification or evaluation of real numbers and algebraic monomial expressions raised to a whole number power and algebraic binomial expressions squared or cubed;		
		1.4.2.f simplification of products and quotients of real number and algebraic monomial expressions using the properties of exponents;		
		1.4.2.g matrix addition, e.g., when computing (with one operation) a building's expenses (data) monthly, a matrix is created to include each of the different expenses; then at the end of the year, each type of expense for the building is totaled;		
		1.4.2.h scalar-matrix multiplication, e.g., if a matrix is created with everyone's salary		

		in it, and everyone gets a 10% raise in pay; to find the new salary, the matrix would be multiplied by 1.1.		
		1.4.3 finds prime factors, greatest common factor, multiples, and the least common multiple of algebraic expressions.		
2 Algebra	**2.1** The student recognizes, describes, extends, develops, and explains the general rule of a pattern in a variety of situations.	**2.1.1** identifies, states, and continues the following patterns using various formats including numeric (list or table), algebraic (symbolic notation), visual (picture, table, or graph), verbal (oral description), kinesthetic (action), and written:	Discrete Mathematics	Sequences and Series: Terms, Sums, and Limits
		2.1.1.a arithmetic and geometric sequences using real numbers and/or exponents; e.g., radioactive half-lives;	Discrete Mathematics	Sequences and Series: Terms, Sums, and Limits
		2.1.1.b patterns using geometric figures;		
		2.1.1.c algebraic patterns including consecutive number patterns or equations of functions, e.g., n, n + 1, n + 2,... or f(n) = 2n - 1;	Discrete Mathematics	Sequences and Series: Terms, Sums, and Limits
		2.1.1.d special patterns, e.g., Pascal's triangle and the Fibonacci sequence.	Discrete Mathematics	Sequences and Series: Convergence, Divergence and Applications
		2.1.2generates and explains a pattern.	Discrete Mathematics	Sequences and Series: Terms, Sums, and Limits
		2.1.3 classify sequences as arithmetic, geometric, or neither.	Discrete Mathematics	Sequences and Series: Terms, Sums, and Limits
		2.1.4 defines:		
		2.1.4.a a recursive or explicit formula for arithmetic sequences and finds any particular term,	Discrete Mathematics	Sequences and Series: Terms, Sums, and Limits
		2.1.4.b a recursive or explicit formula for geometric sequences and finds any particular term.	Discrete Mathematics	Sequences and Series: Terms, Sums, and Limits

	2.2 The student uses variables, symbols, real numbers, and algebraic expressions to solve equations and inequalities in variety of situations.	**2.2.1** knows and explains the use of variables as parameters for a specific variable situation, e.g., the m and b in y = mx + b or the h, k, and r in $(x - h)^2 + (y - k)^2 = r^2$.	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		2.2.2 manipulates variable quantities within an equation or inequality, e.g., 5x - 3y = 20 could be written as 5x - 20 = 3y or 5x(2x + 3) = 8 could be written as 8/(5x) = 2x + 3.	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		2.2.3 solves:		
		2.2.3.a linear equations and inequalities both analytically and graphically;		
		2.2.3.b quadratic equations with integer solutions (may be solved by trial and error, graphing, quadratic formula, or factoring);	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		2.2.3.c systems of linear equations with two unknowns using integer coefficients and constants;	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		2.2.3.d radical equations with no more than one inverse operation around the radical expression;		
		2.2.3.e equations where the solution to a rational equation can be simplified as a linear equation with a nonzero denominator, e.g., 3/(x + 2) = 5/(x - 3).		
		2.2.3.f equations and inequalities with absolute value quantities containing one variable with a special emphasis on using a number line and the concept of absolute value.		
		2.2.3.g exponential equations with the same base without the aid of a calculator or computer, e.g., 3 to the power (x + 2) = 3 to the fifth power.	Exponential and Logarithmic Functions	Properties and Graphs

	2.3 The student analyzes functions in a variety of situations.	**2.3.1** evaluates and analyzes functions using various methods including mental math, paper and pencil, concrete objects, and graphing utilities or other appropriate technology.	Exponential and Logarithmic Functions	Properties and Graphs
		2.3.2 matches equations and graphs of constant and linear functions and quadratic functions limited to $y = ax^2 + c$.		
		2.3.3 determines whether a graph, list of ordered pairs, table of values, or rule represents a function.		
		2.3.4 determines x- and y-intercepts and maximum and minimum values of the portion of the graph that is shown on a coordinate plane.		
		2.3.5 identifies domain and range of:		
		2.3.5.a relationships given the graph or table,		
		2.3.5.b linear, constant, and quadratic functions given the equation(s).		
		2.3.6 recognizes how changes in the constant and/or slope within a linear function changes the appearance of a graph.		
		2.3.7 uses function notation.	Exponential and Logarithmic Functions	Properties and Graphs
		2.3.8 evaluates function(s) given a specific domain.		
		2.3.9 describes the difference between independent and dependent variables and identifies independent and dependent variables.		
	2.4 The student develops and uses mathematical models to represent and justify mathematical	**2.4.1** knows, explains, and uses mathematical models to represent and explain mathematical concepts,	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas

	relationships found in a variety of situations involving tenth grade knowledge and skills.	procedures, and relationships. Mathematical models include:		
		2.4.1.a process models (concrete objects, pictures, diagrams, number lines, hundred charts, measurement tools, multiplication arrays, division sets, or coordinate grids) to model computational procedures, algebraic relationships, and mathematical relationships and to solve equations;		
		2.4.1.b factor trees to model least common multiple, greatest common factor, and prime factorization;		
		2.4.1.c algebraic expressions to model relationships between two successive numbers in a sequence or other numerical patterns;	Discrete Mathematics	Sequences and Series: Terms, Sums, and Limits
		2.4.1.d equations and inequalities to model numerical and geometric relationships;	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		2.4.1.e function tables to model numerical and algebraic relationships;	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		2.4.1.f coordinate planes to model relationships between ordered pairs and equations and inequalities and linear and quadratic functions;	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		2.4.1.g constructions to model geometric theorems and properties;		
		2.4.1.h two- and three-dimensional geometric models (geoboards, dot paper, coordinate plane, nets, or solids) and real-world objects to model perimeter, area, volume, and surface area, properties of two- and three-dimensional figures, and isometric views of three-dimensional figures;		

		2.4.1.i scale drawings to model large and small real-world objects;		
		2.4.1.j Pascal's Triangle to model binomial expansion and probability;	Discrete Mathematics	Sequences, Series: Convergence, Divergence and Applications
		2.4.1.k geometric models (spinners, targets, or number cubes), process models (concrete objects, pictures, diagrams, or coins), and tree diagrams to model probability;		
		2.4.1.l frequency tables, bar graphs, line graphs, circle graphs, Venn diagrams, charts, tables, single and double stem-and-leaf plots, scatter plots, box-and-whisker plots, histograms, and matrices to organize and display data;	Exponential and Logarithmic Functions	Values and Applications
		2.4.1.m Venn diagrams to sort data and to show relationships.		
3 Geometry	**3.1** The student recognizes geometric figures and compares and justifies their properties of geometric figures in a variety of situations.	**3.1.1** recognizes and compares properties of two-and three-dimensional figures using concrete objects, constructions, drawings, appropriate terminology, and appropriate technology.		
		3.1.2 discusses properties of regular polygons related to:		
		3.1.2.a angle measures,		
		3.1.2.b diagonals.		
		3.1.3 recognizes and describes the symmetries (point, line, plane) that exist in three-dimensional figures.		
		3.1.4 recognizes that similar figures have congruent angles, and their corresponding sides are proportional.		
		3.1.5 uses the Pythagorean Theorem to:		
		3.1.5.a determine if a triangle is a right		

		triangle,		
		3.1.5.b find a missing side of a right triangle.		
		3.1.6 recognizes and describes:		
		3.1.6.a congruence of triangles using: Side-Side-Side (SSS), Angle-Side-Angle (ASA), Side-Angle-Side (SAS), and Angle-Angle-Side (AAS);		
		3.1.6.b the ratios of the sides in special right triangles: 30°-60°-90° and 45°-45°-90°.		
		3.1.7 recognizes, describes, and compares the relationships of the angles formed when parallel lines are cut by a transversal.		
		3.1.8 recognizes and identifies parts of a circle: arcs, chords, sectors of circles, secant and tangent lines, central and inscribed angles.		
	3.2 The student estimates, measures and uses geometric formulas in a variety of situations.	**3.2.1** determines and uses real number approximations (estimations) for length, width, weight, volume, temperature, time, distance, perimeter, area, surface area, and angle measurement using standard and nonstandard units of measure.		
		3.2.2 selects and uses measurement tools, units of measure, and level of precision appropriate for a given situation to find accurate real number representations for length, weight, volume, temperature, time, distance, area, surface area, mass, midpoint, and angle measurements.		
		3.2.3 approximates conversions between customary and metric systems given the conversion unit or formula.		

		3.2.4 states, recognizes, and applies formulas for:		
		3.2.4.a perimeter and area of squares, rectangle, and triangles;		
		3.2.4.b circumference and area of circles;		
		3.2.4.c volume of rectangular solids.		
		3.2.5 uses given measurement formulas to find perimeter, area, volume, and surface area of two- and three-dimensional figures (regular and irregular).		
		3.2.6 recognizes and applies properties of corresponding parts of similar and congruent figures to find measurements of missing sides.		
		3.2.7 knows, explains, and uses ratios and proportions to describe rates of change $, e.g., miles per gallon, meters per second, calories per ounce, or rise over run.		
	3.3 The student recognizes and applies transformations on two- and three- dimensional figures in a variety of situations.	**3.3.1** describes and performs single and multiple transformations [reflection, rotation, translation, reduction (contraction/shrinking), enlargement (magnification/growing)] on two- and three-dimensional figures.	Conics, Polar Coordinates and Complex Numbers	Parametric Equations
		3.3.2 recognizes a three-dimensional figure created by rotating a simple two-dimensional figure around a fixed line, e.g., a rectangle rotated about one of its edges generates a cylinder; an isosceles triangle rotated about a fixed line that runs from the vertex to the midpoint of its base generates a cone.		
		3.3.3 generates a two-dimensional representation of a three-dimensional		

		figure.		
		3.3.4 determines where and how an object or a shape can be tessellated using single or multiple transformations and creates a tessellation.		
	3.4 The student uses an algebraic perspective to analyze the geometry of two- and three-dimensional figures in a variety of situations.	**3.4.1** recognizes and examines two- and three-dimensional figures and their attributes including the graphs of functions on a coordinate plane using various methods including mental math, paper and pencil, concrete objects, and graphing utilities or other appropriate technology.		
		3.4.2 determines if a given point lies on the graph of a given line or parabola without graphing and justifies the answer.	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		3.4.3 calculates the slope of a line from a list of ordered pairs on the line and explains how the graph of the line is related to its slope.	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		3.4.4 finds and explains the relationship between the slopes of parallel and perpendicular lines, e.g., the equation of a line $2x + 3y = 12$. The slope of this line is -2/3. What is the slope of a line perpendicular to this line?	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		3.4.5 uses the Pythagorean Theorem to find distance (may use the distance formula).	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		3.4.6 recognizes the equation of a line and transforms the equation into slope-intercept form in order to identify the slope and y-intercept and uses this information to graph the line.	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas
		3.4.7 recognizes the equation $y = ax^2 + c$ as a parabola; represents and identifies	Conics, Polar Coordinates, and	Conics: Circles, Ellipses, Hyperbolas and Parabolas

		characteristics of the parabola including opens upward or opens downward, steepness (wide/narrow), the vertex, maximum and minimum values, and line of symmetry; and sketches the graph of the parabola.	Complex Numbers	
		3.4.8 explains the relationship between the solution(s) to systems of equations and systems of inequalities in two unknowns and their corresponding graphs, e.g., for equations, the lines intersect in either one point, no points, or infinite points; and for inequalities, all points in double-shaded areas are solutions for both inequalities.	Conics, Polar Coordinates, and Complex Numbers	Conics: Circles, Ellipses, Hyperbolas and Parabolas