

MIDLAND ISD
ADVANCED PLACEMENT CURRICULUM STANDARDS

	AP CALCULUS AB	
TEKS	COLLEGE BOARD	COLLEGE AND CAREER READINESS STDS
	<p>Curricular Requirement 1: The course teaches all topics associated with Functions, Graphs, and Limits; Derivatives; and Integrals as delineated in the Calculus AB Topic Outline in the AP Calculus Course Description.</p> <p>Scoring Component 1: The course teaches all topics associated with Functions, Graphs, and Limits as delineated in the Calculus AB Topic Outline in the AP Calculus course description.</p> <p>A. Analysis of graphs</p> <p>B. Limits of functions (including one-sided limits)</p> <ol style="list-style-type: none"> 1. An intuitive understanding of the limiting process. 2. Calculating limits using algebra. 3. Estimating limits from graphs or tables of data. <p>C. Asymptotic and unbounded behavior</p> <ol style="list-style-type: none"> 1. Understanding asymptotes in terms of graphical behavior. 2. Describing asymptotic behavior in terms of limits involving infinity. 3. Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth and logarithmic growth). <p>D. Continuity as a property of functions</p> <ol style="list-style-type: none"> 1. An intuitive understanding of continuity. 	<p>I. Numeric Reasoning</p> <p>A. Number representation</p> <ol style="list-style-type: none"> 1. Compare real numbers. 2. Define and give examples of complex numbers. <p>B. Number operations</p> <ol style="list-style-type: none"> 1. Perform computations with real and complex numbers. <p>C. Number sense and number concepts</p> <ol style="list-style-type: none"> 1. Use estimation to check for errors and reasonableness of solutions. <p>II. Algebraic Reasoning</p> <p>A. Expressions and equations</p> <ol style="list-style-type: none"> 1. Explain and differentiate between expressions and equations using words such as “solve,” “evaluate,” and “simplify.” <p>B. Manipulating expressions</p> <ol style="list-style-type: none"> 1. Recognize and use algebraic (field) properties concepts, procedures, and algorithms to combine, transform, and evaluate expressions (e.g., polynomials, radicals, rational expressions). <p>C. Solving equations, inequalities, and systems of equations</p> <ol style="list-style-type: none"> 1. Recognize and use algebraic (field) properties concepts, procedures, and algorithms to solve equations, inequalities, and systems of linear equations.

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	<p>(The function values can be made as close as desired by taking sufficiently close values of the domain).</p> <ol style="list-style-type: none"> 2. Understanding continuity in terms of limits. 3. Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem). <p>Scoring Component 2: The course teaches all topics associated with Derivatives as delineated in the Calculus AB Topic Outline in the AP Calculus course description.</p> <p>A. Concepts of the derivative</p> <ol style="list-style-type: none"> 1. Derivative presented graphically, numerically, and analytically. 2. Derivative interpreted as an instantaneous rate of change. 3. Derivative defined as the limit of the difference quotient. 4. Relationship between differentiability and continuity. <p>B. Derivative at a point</p> <ol style="list-style-type: none"> 1. Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents. 2. Tangent line to a curve at a point and local linear approximation. 3. Instantaneous rate of change as the 	<ol style="list-style-type: none"> 2. Explain the difference between the solution set of an equation and the solution set of an inequality. <p>D. Representations</p> <ol style="list-style-type: none"> 1. Interpret multiple representations of equations and relationships. 2. Translate among multiple representations of equations and relationships. <p>III. Geometric Reasoning</p> <p>A. Figures and their properties</p> <ol style="list-style-type: none"> 1. Identify and represent the features of plane and space figures. 2. Make, test, and use conjectures about one-,two-,and three-dimensional figures and their properties. 3. Recognize and apply right triangle relationships including basic trigonometry. <p>B. Transformations and symmetry</p> <ol style="list-style-type: none"> 1. Identify and apply transformations to figures. 2. Identify the symmetries of a plane figure. 3. Use congruence transformations and dilations to investigate congruence, similarity, and symmetries of plane figures. <p>C. Connections between geometry and other mathematical content strands</p> <ol style="list-style-type: none"> 1. Make connections between geometry and algebra.

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	<p style="text-align: center;">limit of average rate of change.</p> <p>4. Approximate rate of change from graphs and tables of values.</p> <p>C. Derivative as a function</p> <ol style="list-style-type: none"> 1. Corresponding characteristics of graphs of f and f'. 2. Relationship between the increasing and decreasing behavior of f and the sign of f'. 3. The Mean Value Theorem and its geometric interpretation. 4. Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa. <p>D. Second derivatives</p> <ol style="list-style-type: none"> 1. Corresponding characteristics of the graphs of f, f' and f''. 2. Relationship between the concavity of f and the sign of f''. 3. Points of inflection as places where concavity changes. <p>E. Applications of derivatives</p> <ol style="list-style-type: none"> 1. Analysis of curves, including the notions of monotonicity and concavity. 2. Optimization, both absolute (global) and relative (local) extrema. 3. Modeling rates of change, including related rates problems. 4. Use of implicit differentiation to find the 	<ol style="list-style-type: none"> 2. Make connections between geometry, statistics, and probability. 3. Make connections between geometry and measurement. <p>D. Logic and reasoning in geometry</p> <ol style="list-style-type: none"> 1. Make and validate geometric conjectures. 2. Understand that Euclidean geometry is an axiomatic system. <p>IV. Measurement Reasoning</p> <p>A. Measurement involving physical and natural attributes</p> <ol style="list-style-type: none"> 1. Select or use the appropriate type of unit for the attribute being measured. <p>B. Systems of measurement</p> <ol style="list-style-type: none"> 1. Convert from one measurement system to another. 2. Convert within a single measurement system. <p>C. Measurement involving geometry and algebra</p> <ol style="list-style-type: none"> 1. Find the perimeter and area of two-dimensional figures. 2. Determine the surface area and volume of three-dimensional figures. 3. Determine indirect measurements of figures using scale drawings, similar figures, the Pythagorean Theorem, and basic trigonometry. <p>D. Measurement involving statistics and</p>

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	<p>derivative of an inverse function.</p> <ol style="list-style-type: none"> 5. Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed and acceleration. 6. Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations. <p>F. Computation of derivatives</p> <ol style="list-style-type: none"> 1. Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric and inverse trigonometric functions. 2. Derivative rules for sums, products and quotients of functions. 3. Chain rule and implicit differentiation. <p>Scoring Component 3: The course teaches all topics associated with Integrals as delineated in the Calculus AB Topic Outline in the AP Calculus course description.</p> <p>A. Interpretations and properties of definite integrals</p> <ol style="list-style-type: none"> 1. Definite integral as a limit of Riemann sums. 2. Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the 	<p>probability</p> <ol style="list-style-type: none"> 1. Compute and use measures of center and spread to describe data. 2. Apply probabilistic measures to practical <p>V. Probabilistic Reasoning</p> <p>A. Counting principles</p> <ol style="list-style-type: none"> 1. Determine the nature and the number of elements in a finite sample space. <p>B. Computation and interpretation of probabilities</p> <ol style="list-style-type: none"> 1. Compute and interpret the probability of an event and its complement. 2. Compute and interpret the probability of conditional and compound events. <p>VI. Statistical Reasoning</p> <p>A. Data collection</p> <ol style="list-style-type: none"> 1. Plan a study. <p>B. Describe data</p> <ol style="list-style-type: none"> 1. Determine types of data. 2. Select and apply appropriate visual representations of data. 3. Compute and describe summary statistics of data. 4. Describe patterns and departure from patterns in a set of data. <p>C. Read, analyze, interpret, and draw conclusions from data</p> <ol style="list-style-type: none"> 1. Make predictions and draw inferences using

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	<p>interval: $\int_a^b f'(x) dx = f(b) - f(a)$</p> <p>3. Basic properties of definite integrals (examples include additivity and linearity).</p> <p>B. Applications of integrals</p> <p>1. Appropriate integrals are used in a variety of applications to model physical, biological or economic situations.</p> <p>2. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems.</p> <p>3. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral.</p> <p>4. To produce a common foundation, specific applications should include finding:</p> <ul style="list-style-type: none"> a. the area of a region, b. the volume of a solid with known cross sections, c. the average value of a function, d. the distance traveled by a particle along a line, and 	<p>summary statistics.</p> <p>2. Analyze data sets using graphs and summary statistics.</p> <p>3. Analyze relationships between paired data using spreadsheets, graphing calculators, or statistical software.</p> <p>4. Recognize reliability of statistical results.</p> <p>VII. Functions</p> <p>A. Recognition and representation of functions</p> <p>1. Recognize whether a relation is a function.</p> <p>2. Recognize and distinguish between different types of functions.</p> <p>B. Analysis of functions</p> <p>1. Understand and analyze features of a function.</p> <p>2. Algebraically construct and analyze new functions.</p> <p>C. Model real world situations with functions</p> <p>1. Apply known function models.</p> <p>2. Develop a function to model a situation.</p> <p>VIII. Problem Solving and Reasoning</p> <p>A. Mathematical problem solving</p> <p>1. Analyze given information.</p> <p>2. Formulate a plan or strategy.</p> <p>3. Determine a solution.</p> <p>4. Justify the solution.</p> <p>5. Evaluate the problem-solving process.</p>

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	<p style="text-align: center;">e. accumulated change from a rate of change.</p> <p>C. Fundamental Theorem of Calculus</p> <ol style="list-style-type: none"> 1. Use of the Fundamental Theorem to evaluate definite integrals. 2. Use of the fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined. <p>D. Techniques of antidifferentiation</p> <ol style="list-style-type: none"> 1. Antiderivatives following directly from derivatives of basic functions. 2. Antiderivatives by substitutions of variables (including change of limits for definite integrals). <p>E. Applications of antidifferentiation</p> <ol style="list-style-type: none"> 1. Finding specific antiderivatives using initial conditions, including applications to motion along a line. 2. Solving separable differential equations and using them in modeling including the study of the equation $y' = ky$ and exponential growth). <p>F. Numerical approximations to definite integrals</p> <ol style="list-style-type: none"> 1. Use of Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically 	<p>B. Logical reasoning</p> <ol style="list-style-type: none"> 1. Develop and evaluate convincing arguments. 2. Use various types of reasoning. <p>C. Real world problem solving</p> <ol style="list-style-type: none"> 1. Formulate a solution to a real world situation based on the solution to a mathematical problem. 2. Use a function to model a real world situation. 3. Evaluate the problem-solving process. <p>IX. Communication and Representation</p> <p>A. Language, terms, and symbols of mathematics</p> <ol style="list-style-type: none"> 1. Use mathematical symbols, terminology, and notation to represent given and unknown information in a problem. 2. Use mathematical language to represent and communicate the mathematical concepts in a problem. 3. Use mathematics as a language for reasoning, problem solving, making connections, and generalizing. <p>B. Interpretation of mathematical work</p> <ol style="list-style-type: none"> 1. Model and interpret mathematical ideas and concepts using multiple representations. 2. Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.

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	<p style="text-align: center;">and by tables of values.</p> <p>Curricular Requirement 2: The course provides students with the opportunity to work with functions represented in a variety of ways – graphically, numerically, analytically, and verbally – and emphasizes the connections among these representations.</p> <p>Scoring Component 4: The course provides students the opportunity to work with functions represented graphically.</p> <p>Scoring Component 5: The course provides students the opportunity to work with functions represented numerically.</p> <p>Scoring Component 6: The course provides students the opportunity to work with functions represented analytically.</p> <p>Scoring Component 7: The course provides students the opportunity to work with functions represented verbally.</p> <p>Curricular Requirement 3: The course teaches students how to communicate mathematics and explain solutions to problems both verbally and in written sentences.</p> <p>Scoring Component 8: The course teaches students how to explain solutions to problems orally.</p> <p>Scoring Component 9: The course teaches</p>	<p>C. Presentation and representation of mathematical work</p> <ol style="list-style-type: none"> 1. Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words. 2. Create and use representations to organize, record, and communicate mathematical ideas. 3. Explain, display or justify mathematical ideas and arguments using precise mathematical language in written or oral communication. <p>X. Connections</p> <p>A. Connections among the strands of mathematics</p> <ol style="list-style-type: none"> 1. Connect and use multiple strands of mathematics in situations and problems. 2. Connect mathematics to the study of other disciplines. <p>B. Connections of mathematics to nature, real world situations, and everyday life</p> <ol style="list-style-type: none"> 1. Use multiple representations to demonstrate links between mathematical and real world situations. 2. Understand and use appropriate mathematical models in the natural, physical, and social sciences. 3. Know and understand the use of mathematics in a variety of careers and professions.

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	<p>students how to explain solutions to problems in written sentences.</p> <p>Curricular Requirement 4: The course teaches students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions.</p> <p>Scoring Component 10: The course teaches students how to use graphing calculators to help solve problems.</p> <p>Scoring Component 11: The course teaches students how to use graphing calculators to experiment.</p> <p>Scoring Component 12: The course teaches students how to use graphing calculators to interpret results and support conclusions.</p>	