STAFFORD COUNTY PUBLIC SCHOOLS

Curriculum Overview
Advanced Placement Calculus AB and BC

Course Description:

AP Calculus AB addresses the theory and practice of differential and integral calculus of a function of one variable. Topics include functional analysis, limits, continuity, the derivative and applications, and solving problems that deal with the rate of change. The content of this course is equivalent to one semester of college calculus.

AP Calculus BC covers the same topics as that covered in AB Calculus. In addition, students in Calculus BC will apply calculus techniques to polar curves, parametric equations, vector function sequences and series, and slope fields. The content of this course is equivalent to two semesters of college calculus.

Advanced Placement Calculus is designed around a national framework to prepare students to take the advanced placement examination in May for possible college credit. Please see the math department chairperson for further information.

Essential Skills/Processes:

Calculus has its own language. The vocabulary and symbols are very important to a student's understanding of calculus concepts. Students will use mathematical skills, symbols, and vocabulary to read and communicate about calculus. Students will apply calculus concepts in solving practical problems.

In May, students must take the national Advanced Placement Calculus examination for possible college credit.

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Essential Knowledge:

- Define and apply the properties of elementary functions, including algebraic, trigonometric, exponential, and composite functions and their inverses, and graph these functions using a graphing calculator. Properties of functions will include domains, ranges, combinations, odd, even, periodicity, symmetry, asymptotes, zeros, upper and lower bounds, and intervals where the function is increasing or decreasing.
- Define and apply the properties of limits of functions. This will include limits of a constant, sum, product, quotient, one-sided limits, limits at infinity, infinite limits, and nonexistent limits.
- State the definition of continuity and determine where a function is continuous or discontinuous. This will include
  - continuity at a point;
  - continuity over a closed interval;
  - application of the Intermediate Value Theorem; and
  - graphical interpretation of continuity and discontinuity.
- Find the derivative of an algebraic function by using the definition of a derivative. This will include investigating and describing the relationship between differentiability and continuity.
- Apply formulas to find the derivative of algebraic, trigonometric, exponential, and logarithmic functions and their inverses.
- Apply formulas to find the derivative of the sum, product, quotient, inverse, and composite (chain rule) of elementary functions.
- Find the derivative of an implicitly defined function.
- Find the higher order derivatives of algebraic, trigonometric, exponential, and logarithmic functions.
- Use logarithmic differentiation as a technique to differentiate nonlogarithmic functions.
- State (without proof) the Mean Value Theorem for derivatives and apply it both algebraically and graphically.
- Use l'Hopital's rule to find the limit of functions whose limits yield the indeterminate forms.
- Apply the derivative to solve problems, including tangent and normal lines to a curve, curve sketching, velocity, acceleration, related rates of change, Newton's method, differentials and linear approximations, and optimization problems.

- Find the indefinite integral of algebraic, exponential, logarithmic, and trigonometric functions. The special integration techniques of substitution (change of variables) and integration by parts will be included.
- Identify the properties of the definite integral. This will include the Fundamental Theorem of Calculus and the definite integral as an area and as a limit of a sum as well as the fundamental theorem:

$$\frac{d}{d(x)} \qquad f(t)\, d(t) = f(x)$$

- *AP Calculus BC will include composite functions defined by integrals, e.g.,

$$f(x) = \qquad e^{-t5}\, d(t)$$

- Apply the definite integral to solve problems. These problems will include finding distance traveled on a line and velocity from acceleration with initial conditions, growth and decay problems, solutions of separable differential equations, the average value of a function, area between curves, volumes of solids of revolution about the axes or lines parallel to the axes using disc/washer and shell methods, and volumes of solids with known cross-sectional areas.
- Compute and approximate value for a definite integral. This will include numerical calculations using Riemann Sums and the Trapezoidal Rule.
- Find the derivatives of vector functions and parametrically defined functions and use them to solve problems. The problems will include tangent and normal lines to parametrically defined curves, velocity and acceleration, and velocity and acceleration vectors for motion on a plane curve.
- Use integration to solve problems. This will include areas bounded by polar curves, length of a path (including parametric curves), work (Hooke's law), and improper integrals.
- Define and test for convergence of a series of real numbers and of functions. This will include geometric series, comparison (including limit comparison), ratio, root, and integral tests, absolute and conditional convergence, alternating series and error approximation, and p-series.
- Define, restate, and apply power series. This will include addition, substitution, term-by-term differentiation and integration, interval of convergence, Taylor's series, Maclaurin series expansions, and Taylor polynomials with remainder and Lagrange error approximation.

Resources:

- Stafford County Public Schools: http://stafford.schoolfusion.us/ .
- High School Course Catalog: http://stafford.schoolfusion.us/ . Click on "For Parents/Students" tab.
- VA Mathematics Standards of Learning: http://www.doe.virginia.gov/testing/sol/standards_docs/mathematics/review.shtml
- School Report Card (VA Department of Education): http://www.doe.virginia.gov/statistics_reports/school_report_card/index.shtml
- AP Central AP Calculus AB Course Home Page: http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/2178.html
- AP Central AP Calculus BC Course Home Page: http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/2118.html