AP Calculus BC Big Idea 3: Analysis of Functions (FUN)

Calculus allows us to analyze the behaviors of functions by relating limits to differentiation, integration, and infinite series and relating each of these concepts to the others.

FUN-1

Existence theorems allow us to draw conclusions about a function's behavior on an interval without precisely locating that behavior.

- 1.A Explain the behavior of a function on an interval using the Intermediate Value Theorem.
- 1.B Justify conclusions about functions by applying the Mean Value Theorem over an interval.
- 1.C Justify conclusions about functions by applying the Extreme Value Theorem.

FUN-2

Recognizing that a function's derivative may also be a function allows us to develop knowledge about the related behaviors of both.

- 2.A Explain the relationship between differentiability and continuity.

FUN-3

Recognizing opportunities to apply derivative rules can simplify differentiation.

- 3.A Calculate derivatives of familiar functions.
- 3.B Calculate derivatives of products and quotients of differentiable functions.
- 3.C Calculate derivatives of compositions of differentiable functions.
- 3.D Calculate derivatives of implicitly-defined functions.
- 3.E Calculate derivatives of inverse and inverse trigonometric functions.
- 3.F Determine higher-order derivatives of a function.
- 3.G Calculate derivatives of functions written in polar coordinates.

FUN-4

A function's derivative can be used to understand some behaviors of the function.

- 4.A Justify conclusions about the behavior of a function based on the behavior of its derivatives.
- 4.B Calculate minimum and maximum values in applied contexts or analysis of functions.
- 4.C Interpret minimum and maximum values calculated in applied contexts.
- 4.D Determine critical points of implicit relations.
- 4.E Justify conclusions about the behavior of an implicitly-defined function based on evidence from its derivatives.

FUN-5

The Fundamental Theorem of Calculus connects differentiation and integration.

- 5.A Represent accumulation functions using definite integrals.

FUN-6

Recognizing opportunities to apply knowledge of geometry and mathematical rules can simplify integration.

- 6.A Calculate a definite integral using areas and properties of definite integrals.
- 6.B Evaluate definite integrals analytically using the Fundamental Theorem of Calculus.
- 6.C Determine antiderivatives of functions and indefinite integrals, using knowledge of derivatives.
- 6.D For integrands requiring substitution or rearrangements into equivalent forms: (a) determine indefinite integrals; and (b) evaluate definite integrals.
- 6.E For integrands requiring integration by parts: (a) determine indefinite integrals; and (b) evaluate definite integrals.
- 6.F For integrands requiring integration by linear partial fractions: (a) determine indefinite integrals; and (b) evaluate definite integrals.

FUN-7

Solving differential equations allows us to determine functions and develop models.

- 7.A Interpret verbal statements of problems as differential equations involving a derivative expression.
- 7.B Verify solutions to differential equations.
- 7.C Estimate solutions to differential equations.
- 7.D Determine general solutions to differential equations.
- 7.E Determine particular solutions to differential equations.
- 7.F Interpret the meaning of a differential equation and its variables in context.
- 7.G Determine general and particular solutions for problems involving differential equations in context.
- 7.H Interpret the meaning of the logistic growth model in context.

FUN-8

Solving an initial value problem allows us to determine an expression for the position of a particle moving in the plane.

- 8.A Determine a particular solution given a rate vector and initial conditions.
- 8.B Determine values for positions and rates of change in problems involving planar motion.

FUN-3, FUN-4, FUN-6, and FUN-7 are flagged as "priority"—that is, the content covered by those EU statements is extremely important or foundational.
Students who fail to "meet" or "exceed" all priority EUs by the end of the term may not receive a grade higher than a C.