Pequea Valley School District
Math

Course: AP Calculus BC Grade: 12

Unit 1: Connecting Calculus AB to BC

Unit Essential Question: How can you extend the ideas from AP Calculus AB?

CONCEPT
Newton's and Euler's Methods
VOCABULARY
Linearization, Tangent to a Curve, Initial Guess, Differentials, True Absolute Change, Estimated Change
KNOW
• Tangent lines • Differential equations
UNDERSTAND
• How linearizations lead to solving for the zero of a function • How the solutions to differential equations can be approximated by differentials
LEARNING OUTCOME
• Learners will be able to apply Newton's Method to approximate the solution of a function. • Learners will be able to apply Euler's Method to approximate the values of a function.

CONCEPT
Integration Techniques
VOCABULARY
Integration by Parts, LIPET, Unknown Integral,Tabular Integration, Partial Fraction Decomposition
KNOW
• Integration by parts • Integration with partial fractions
UNDERSTAND
• How to use different integration techniques to evaluate integrals
LEARNING OUTCOME
• Learners will be able to evaluate an integral using integration by parts. • Learners will be able to evaluate an integral using fraction decomposition.

CONCEPT
Applications of Integrals
VOCABULARY
Logistic Growth, Carrying Capacity, Growth Constant, Cylindrical Shells, Length of a Curve
KNOW
• Logistic function • Rotational volume • Surface Area of a cylinder • Distance formula
UNDERSTAND
• How the growth rate of a logistic function can be written • How to calculate the volume of a thin, cylindrical shell • How to calculate the length of a curve
LEARNING OUTCOME
• Learners will be able to solve differential equations that model logistic growth. • Learners will be able to calculate the volume of a solid formed from revolving an area around an axis of revolution using the shell method. • Learners will be able to

		calculate the length of a curve.

College Board Curriculum Framework:

LO 2.3B
Solve problems involving the slope of a tangent line.
LO 2.3D
Solve problems involving rates of change in applied contexts.
LO 2.3E
Verify solutions to differential equations.
LO 2.3F
Estimate solutions to differential equations.
LO 3.3B(a)
Calculate antiderivatives.
LO 3.3B(b)
Evaluate definite integrals.
LO 3.4A
Interpret the meaning of a definite integral within a problem
LO 3.4D
Apply definite integrals to problems involving area, volume, and length of a curve.
LO 3.4E
Use the definite integrals to solve problems in various contexts.
LO 3.5A
Analyze differential equations to obtain general and specific solutions.
LO 3.5B
Interpret, create, and solve differential equations from problems in context.

Assessments: Unit Assessment

Pacing: 25 days (including assessment)

Resources: Schoology, Pearson Calculus AP* Edition, AP Central website

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Unit 2: Parametric, Vector, and Polar Representations

Unit Essential Question: **How can you apply single-variable calculus to two-variable contexts ?**

CONCEPT
Parametric Equations
VOCABULARY
Parametric Equation, Parameter, Parameter Interval, Initial Point, Terminal Point, Parametrization, Astroid, Cycloid
KNOW
• The difference between cartesian and parametric equations
UNDERSTAND
• How parametric equations are written and graphed. • How parametric equations are differentiated.

CONCEPT
Vectors
VOCABULARY
Vector, Position Vector, Component Form, Components, Standard Representation, Magnitude, Absolute Value, Direction Angle, Initial Point, Terminal Point, Head Minus Tail Rule, Scalar, Position Vector, Velocity Vector, Speed, Acceleration Vector, Direction Vector, Planar Motion, Displacement, Distance Traveled
KNOW
• Vectors • Vector Operations
UNDERSTAND
• How vectors are represented graphically • How vectors are added and multiplied by a scalar • How vectors represent planar motion

CONCEPT
Polar Equations
VOCABULARY
Polar Coordinates, Pole, Initial Ray, Polar Curve, Area Between Curves
KNOW
• The difference between cartesian and polar equations • The difference between parametric and polar equations
UNDERSTAND
• How polar equations are written and graphed. • How polar equations are differentiated.

LEARNING OUTCOME	LEARNING OUTCOME	LEARNING OUTCOME
• Learners will be able to graph a parametric equation. • Learners will be able to convert from parametric form into cartesian form. • Learners will be able to differentiate parametric equations. • Learners will be able to determine the highest, lowest, leftmost, and rightmost points of a parametrically defined curve. • Learners will be able to determine the concavity of a parametrically defined curve.	• Learners will be able to represent vectors graphically and in component form. • Learners will be able to use vectors to represent planar motion.	• Learners will be able to graph a polar equation. • Learners will be able to convert from polar form into cartesian form. • Learners will be able to differentiate polar equations. • Learners will be able to calculate the area between two polar curves.

College Board Curriculum Framework:

LO 2.1C
Calculate derivatives.
LO 2.1C
Determine higher order derivatives.
LO 2.2A
Use derivatives to analyze properties of a function.
LO 2.3A
Interpret the meaning of a derivative within a problem.
LO 2.3C
Solve problems involving related rates, optimization, rectilinear motion, and planar motion.
LO 2.3E
Verify solutions to differential equations.
LO 2.3F
Estimate solutions to differential equations.
LO 3.3B(a)
Calculate antiderivatives.
LO 3.3B(b)
Evaluate definite integrals.
LO 3.4A
Interpret the meaning of a definite integral within a problem
LO 3.4C
Apply definite integrals to problems involving motion.
LO 3.4D
Apply definite integrals to problems involving area, volume, and length of a curve.
LO 3.4E
Use the definite integrals to solve problems in various contexts.

Assessments: **Unit Assessment**

Pacing: **27 days (including assessment)**

Resources: Schoology, Pearson Calculus AP* Edition, AP Central website

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Course: AP Calculus BC Grade: 12

Unit 3: Sequences and Improper Integrals

Unit Essential Question: How can you determine if sequences and improper integrals converge or diverge ?

CONCEPT	CONCEPT	CONCEPT	CONCEPT
Continuity	**The Extreme Value and Mean Value Theorems**	**Optimization and Linearization**	**Related Rates**
VOCABULARY	**VOCABULARY**	**VOCABULARY**	**VOCABULARY**
Continuity at a Point, Removable Discontinuity, Jump Discontinuity, Infinite Discontinuity, Intermediate Value Theorem	Absolute extrema, Local extrema, Critical Points, The Extreme Value Theorem, The Mean Value Theorem	Optimization, Maximize, Minimize, Linearization, Local Linearity	Related Rates
KNOW	**KNOW**	**KNOW**	**KNOW**
• Continuity • Intermediate Value Theorem	• Extrema • The Extreme Value Theorem • The Mean Value Theorem	• Mathematical Models • Forms of linear equations	• Rates of Change
UNDERSTAND	**UNDERSTAND**	**UNDERSTAND**	**UNDERSTAND**
• How to determine if a function is continuous at a point • How to apply the Intermediate Value Theorem	• How to identify the extrema of a function • How to apply the Extreme Value Theorem • How to apply the Mean Value Theorem	• How to create a mathematical model for a particular situation • Differentiable functions are locally linear	• Quantities can change at different rates.
LEARNING OUTCOME	**LEARNING OUTCOME**	**LEARNING OUTCOME**	**LEARNING OUTCOME**
• Learners will be able to analyze functions for intervals of continuity or points of discontinuity. • Learners will be able to determine the applicability of important calculus theorems using continuity.	• Learners will be able to use derivatives to identify the extrema of a function • Learners will be able to use derivatives to apply the Mean Value Theorem	• Learners will be able to use derivatives to optimize a quantity in a particular situation. • Learners will be able to use linearization to approximate a function's values.	• Learners will be able to use related rates to solve a problem with multiple changing quantities.

CONCEPT

Definite Integrals & The Trapezoidal Rule

VOCABULARY

Left Rectangular Approximation Method (LRAM), Right Rectangular Approximation Method (RRAM), Midpoint Rectangular Approximation Method (MRAM), Riemann Sum, Trapezoidal Approximation

KNOW

- Area of a rectangle
- Definite integrals
- Properties of Definite Integrals
- Area of a Trapezoid
- The trapezoidal rule

UNDERSTAND

- How to approximate the area under a curve using rectangles
- The relationship between the area under a curve and an integral
- How to approximate the area under a curve using trapezoids

LEARNING OUTCOME

- Learners will be able to calculate a definite integral using areas and properties of definite integrals.
- Learners will be able to interpret the definite integral as the limit of a Riemann sum.
- Learners will be able to express the limit of a Riemann sum in integral notation.
- Learners will be able to approximate a definite integral.

CONCEPT

The Fundamental Theorem of Calculus

VOCABULARY

Fundamental Theorem of Calculus Part 1 and Part 2, Total Area

KNOW

- The Fundamental Theorem of Calculus
- Total area

UNDERSTAND

- How to differentiate an integral
- How to evaluate a definite integral using an antiderivative
- The difference between area under a curve and total area

LEARNING OUTCOME

- Learners will be able to analyze functions defined by an integral
- Learners will be able to find the derivative of an integral.

College Board Curriculum Framework:

LO 1.2A
Analyze functions for intervals of continuity or points of discontinuity.
LO 2.2A
Use derivatives to analyze the properties of a function.
LO 2.2B
Recognize the connection between differentiability and continuity.
LO 2.3C
Solve problems involving related rates, optimization, and rectilinear motion.
LO 2.3D
Solve problems involving rates of change in applied contexts.
LO 2.4A
Apply the Mean Value Theorem to describe the behavior of a function over an interval.
LO 3.2A(a)
Interpret the definite integral as the limit of a Riemann sum.
LO 3.2A(b)
Express the limit of a Riemann sum in integral notation.
LO 3.2B
Approximate a definite integral.

Assessments: Unit Assessment

Pacing: 10 days (including assessment)

Resources: Schoology, Pearson Calculus AP* Edition, AP Central website

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Unit 4: Sequences and Improper Integrals

Unit Essential Question: **How can you determine if sequences and improper integrals converge or diverge ?**

CONCEPT
Sequences
VOCABULARY
Sequence, Terms, nth Term, Finite Sequence, Infinite Sequence, Explicitly, Recursively, Arithmetic Sequence, Common Difference, Geometric Sequence, Common Ratio, Converge, Diverge
KNOW
• Arithmetic Sequences • Geometric Sequences
UNDERSTAND
• How sequences are defined. • How to determine the limit of a sequence.
LEARNING OUTCOME
• Learners will be able to define a sequence. • Learners will be able to determine the limit of a sequence.

CONCEPT
Improper Integrals
VOCABULARY
Improper Integrals
KNOW
• Improper integrals as limits
UNDERSTAND
• How to evaluate improper integrals.
LEARNING OUTCOME
• Learners will be able to evaluate improper integrals with infinite limits. • Learners will be able to evaluate improper integrals with infinite discontinuities.

College Board Curriculum Framework:

LO 1.1A(a)
Express limits symbolically using correct notation.
LO 1.1A(b)
Interpret limits expressed symbolically
LO 3.2D
Evaluate an improper integral or show that an improper integral diverges.

Assessments: Unit Assessment

Pacing: 16 days (including assessment)

Resources: Schoology, Pearson Calculus AP* Edition, AP Central website

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Unit 5: Numeric Series

Unit Essential Question: How can you determine if an infinite series converges or diverges?

CONCEPT
Infinite Series
VOCABULARY
Infinite Series, Terms, nth Term, Partial Sums, Converge, Diverge, Geometric Series, Telescoping Series, p-Series, Harmonic Series, Alternating Series, Alternating Harmonic Series
KNOW
• Geometric Sequences • Common Types of Series
UNDERSTAND
• How to write an infinite series in expanded form • How to determine what a Geometric Series converges to • How to determine what a Telescoping Series converges to
LEARNING OUTCOME
• Learners will be able to identify Geometric and Telescoping Series • Learners will be able to calculate what a Geometric and Telescoping Series converges to

CONCEPT
Convergence
VOCABULARY
Geometric Series Test, nth Term Test, Integral Test, p-Series Test, Ratio Test, Limit Comparison Test, Direct Comparison Test, Alternating Series Test, Converges Absolutely, Converges Conditionally
KNOW
• Tests for Convergence • Tests for Divergence • Absolute Convergence • Conditional Convergence
UNDERSTAND
• How to test a series for convergence or divergence • How to determine if a series converges conditionally or absolutely
LEARNING OUTCOME
• Learners will be able to test infinite series for convergence or divergence • Learners will be able to determine if a series converges conditionally or absolutely

College Board Curriculum Framework:

LO 4.1A
Determine whether a series converges or diverges.
LO 4.1B
Determine or estimate the sum of a series

Assessments: Unit Assessment

Pacing: 21 days (including assessment)

Resources: Schoology, Pearson Calculus AP* Edition, AP Central website