AP Calculus BC

J.S. Morton HS District 201
2024-2025

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COURSE DESCRIPTION

In this course, students will develop an understanding of Calculus concepts such as derivatives, integration, area, volume, polynomial approximations, and series and explore practical applications using technology. The goal of this course is to successfully prepare students to take the AP Calculus BC exam.

What will students learn in this course?

Key Concepts	Standards (Students will)
SEMESTER 1	
Functions, Graphs, and Limits	Find the limits of functions graphically, numerically, and analytically
	Understand the continuity of a function
	Discuss one-sided limits
	Use limits to find limits at infinity and infinite limits
	Analyze planar curves including parametric, polar, and vector form.
Differentiation	Use and apply the definition of the derivative
	Understand basic rules of differentiation, including trig, parametric, polar, and vector functions
	Apply the product and quotient rules to differentiate functions.
	Make connections between position, velocity, and acceleration
	Understand the difference between instantaneous and average rate of change.
	Analyze planar curves in vector form, including velocity and acceleration
Differentiation Continued	Apply the chain rule to differentiate functions.
	Understand basic rules of differentiation, including exponential, logarithmic, parametric, polar, and vector functions
	Analyze planar curves in parametric, polar, and vector form, including velocity and acceleration
	Apply rules of differentiation to implicit equations.
Definite Integrals	Calculate areas using the rectangular approximation methods.
	Use Riemann Sums with uneven subintervals.
	Use the definite integral as a limit of Riemann Sums.
	Use technology to calculate the definite integral.
	Understand the Mean Value Theorem for Integrals and Average Value Theorem
	Understand basic rules of antidifferentiation, including trig, logarithmic, exponential, parametric, polar, and vector functions
	Apply the technique of substitution, integration by parts, and partial fractions to antidifferentiate functions
	Use the Fundamental Theorem of Calculus to find the derivative of an integral
	Use the definite integral as a limit of Trapezoid Sums
Differential Equations & Mathematical Modeling	Construct and analyze slope fields
	Determine numerical solutions of differential equations using Euler's method
	Solve separable and logistic differential equations
	Apply differential equations to real-life problems

SEMESTER 2	
Applications of Definite Integrals	Determine the area between curves and the area enclosed by intersecting curves with respect to x
	Determine the area between curves and the area enclosed by intersecting curves with respect to y
	Determine the area bounded by polar curves
	Calculate the volume of a solid using Disk and Washer Method
	Calculate the volume of a solid using Cross Sections
	Find the length of a curve, including a curve given in parametric form
L'Hôpital's Rule and Improper Integrals	Apply L'Hôpital's Rule, including its use in determining limits and convergence of improper integrals and series
	Apply the technique of improper integrals as limits of definite integrals
Infinite Series	Understand the concept of series as a sequence of partial sums as converging or diverging with motivating examples
	Use Taylor polynomial approximation with graphical demonstration of convergence
	Manipulate Taylor series centered at $x = a$ including substitution, differentiation, antidifferentiation, and the formation of new series from known series
	Identify and use the Maclaurin series centered at $x = a$ for the functions e^x, sin x, cos x, and $1/(1–x)$
	Use Lagrange error bound for Taylor polynomials
	Determine radius and interval of convergence of power series
	Understand the convergence of geometric, harmonic, and alternating series
	Determine appropriate tests for convergence, including ratio, n^{th} term, integral, and comparison tests

How will we know students have learned it?

Grade Scale	A – Advanced/ Exemplary	B – Proficient	C – Basic	D – Needs Improvement	E – Not Passing	I – Incomplete
	4.0-5.0	3.0-3.9	2.0-2.9	1.0-1.9	0.1-0.9	Redo

Key Concepts Weights	**Semester 1**		**Semester 2**	
	Functions, Graphs, and Limits	5%	Applications of Definite Integrals	30%
	Differentiation	12.5%	L'Hôpital's Rule and Improper Integrals	20%
	Differentiation Continued	12.5%	Infinite Series	30%
	Applications of Derivatives	20%	AP Exam Review	20%
	Definite Integrals	20%	AP Calculus Exam	
	Differential Equations & Mathematical Modeling	10%		
	AP Calculus Practice Exam			

Within each unit, assignments will be graded according to the following weights:

Assignment Categories		
	Common unit Assessments (Comprehensive unit exams; 1 per unit)	60%
	Interim Classroom Assessments (Quizzes, projects; 2-3 per unit)	30%
	Formative Assignments (Homework, In-class assignments, etc.; varies)	10%

Formative assignments are 10% in each unit because students should not be unduly penalized for mistakes during the learning process. The grade is primarily based on mastery of standards, and mastery is demonstrated on assessments.

Course Requirements	What must every student pass to earn credit on this course? All students must pass each unit with a 1.0.
	What must every student complete to earn credit in the course? Every student must take the practice AP Exam at the end of semester 1. Ever student must take the AP Calculus Exam in May.
	What other requirements must every student meet? Every student must meet weekly with their study groups. Every student must either: participate in Mathletes, perform peer tutoring or receive tutoring from teacher.

During the semester, any Unit grade below 1.0 will override the overall grade to Incomplete. Students who do not meet the course requirements by the end of the semester will receive a grade of E.

The College Board has instituted a new $40 unused student exam fee. This fee will be applied to a student's District 201 financial account balance when:

- A student drops an AP Class after November 15th
- A student does not take an exam(s) during the identified testing period (May 5th – 16th) or late testing period (May 19th – 23rd)
- Please note that the $40 unused student exam fee is per class.

Homework Rubric

0	1	2	3	4	5
more than 2 homework assignments missing or incomplete for the Unit	2 homework assignments missing or incomplete for the Unit	1 homework assignment missing or incomplete for the Unit	all homework assignments for the Unit completed	all homework assignments accurately completed for the Unit	all homework assignments accurately completed with proper notation for the Unit

Missing Assignment – student did not complete for discussion that day
Incomplete Assignment – student did not attempt ALL problems

Participation in weekly Study Groups is part of the Homework grade. Failure to complete a study group for a week will result in 0.5 deduction from the Homework grade.

Study Groups: U and US in Calculus

Doing well in Calculus is a team effort; there is both you and us in Calc**ulus**. You will meet once each week with a study group until the AP Exam in May. Each week ends on Fridays at 1:55pm (end of 6th hour). You may meet for a minimum of either one hour before/after school or for 2 half-hours during supervision. You can always choose to meet for more time.

The total number of students in your study group should be 3 to 5, including you. Meeting in your study group will count as a homework assignment. Group members must be of the same course (all AB or all BC), but AB groups can invite BC students to visit their group to give extra help. BC students are encouraged to find out if AB groups need help.

You do not have to meet with the same students each week. Your goal should be to find a group that fits right.

Each time you meet, you will need to fill out the study group form found at https://forms.gle/TLaPe3njD7HkUafG7 or at www.mathkanection.com on the AP Calculus AB or BC home page. You must log your study group session when your study group meets. End your study group session 5 minutes early to fill out the study group form.

Late submissions will NOT be accepted.

Assessment Rubric

Each question on a test or quiz will be given a value from 0 – 5

0	1	2	3	4	5
No work or no relevant Calculus work	Major error in relevant Calculus work	Minor error in relevant Calculus work	Computation error	Error in notation	Proper notation used throughout problem

AB Part of Summer Work Rubric

	5	4	3	2	1	0
Part I	Completed all topics on-time with 100% success on topics	Completed all topics on-time with 86-99% success on topics	Completed all topics on-time with 75-85% success on topics	Completed all topics on-time with 61-74% success on topics	Completed all topics on-time with 50-60% success on topics	Not completed on-time OR missing topics OR less than 50% success on topics
Part II	Completed all topics on-time with 100% success on topics	Completed all topics on-time with 86-99% success on topics	Completed all topics on-time with 75-85% success on topics	Completed all topics on-time with 61-74% success on topics	Completed all topics on-time with 50-60% success on topics	Not completed on-time OR missing topics OR less than 50% success on topics
Part III	Completed all topics on-time with 100% success on topics	Completed all topics on-time with 86-99% success on topics	Completed all topics on-time with 75-85% success on topics	Completed all topics on-time with 61-74% success on topics	Completed all topics on-time with 50-60% success on topics	Not completed on-time OR missing topics OR less than 50% success on topics

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What will we do when students aren't learning?

Extra Help

Students who are not earning an A, B, or C in the course are expected to seek extra help. Further, any student who wants to improve his or his or her performance and grade is encouraged to ask for support, as well. AP review sessions will be available second semester.

* Room 351 during 5th hour Math Lab, after school (except for Mathletes' meeting/competition days)

* **ADDITIONAL RESOURCES**

In addition to Ms. Kane's and your classmates' help, the following are a sample of websites that you should utilize to help you understand Calculus.

www.mathkanection.com – Ms. Kane's website
https://achieve.bfwpub.com/courses/jxbmet -- Online textbook
www.khanacademy.org – use your login to see suggested lessons, but you can learn any topic
www.patrickjmt.com – helpful math videos
www.wolframalpha.com – help for solving problems
https://myap.collegeboard.org/ -- AP Classroom

Calculus Re-do Policy

Students are eligible and **expected** to re-do tests that do not meet or exceed standards. Students will be provided one opportunity for re-do on a given item.

Students must request a re-do after receiving the graded assignment. The requirements that must be met prior to re-do:

- All Questions on Original Test must have been attempted (no problems left blank).
- Student must have accurately completed all homework assignments for the Unit.
- Students must attend weekly study group sessions for the Unit.
- Student must have completed all Quizzes in a timely manner. (if absent on day of a Quiz, the student must have taken the Quiz on the day they returned to school)
- Student must schedule and attend a help session at least two days before the redo to study for the re-do.
- Re-dos will be taken at specified time, one week after the original assessment was returned.

The maximum grade earned shall be full credit, given the original item is submitted on time with full effort.

District Re-Do Policy:
J. Sterling Morton High School District 201 holds high standards for student achievement. To maintain high expectations and provide support for all students to meet them, the district enforces a redo policy for student work that does not meet or exceed standards.

Students are eligible and expected to redo required assignments that do not have a score above 1.0. Formative and Interim assignments not considered required may be eligible for redo only at the teacher's discretion. The teacher will communicate time sensitive deadline for redo. Student will engage in a relearning experience before completing the redo.

If not already required by the teacher, students must request a redo within one week after receiving the graded assignment from the teacher. The teacher will communicate to the student any requirements that must be met prior to the redo (i.e. after-school tutoring, extra practice assignments, etc.), as well as the deadline for submission. Redo deadlines are described below.

In cases other than common assessments, teachers may provide an alternative assignment for students to demonstrate mastery of the standards.

- A redo for a required assignment can be completed by following the Pre-Calculus redo policy (see above).
- If a required assignment is not redone, the original score of the assignment will be given.

What will we do when students have already learned it?

Students who master the standards before the end of the unit will be offered enrichment assignments or projects to extend their learning. Students who decline are expected to complete required unit assignments and assessments.

Procedures

- Students are expected to inquire about missed learning/assignments immediately upon return from an absence.
- Daily participation is expected.
- Field Trips are a reward for reaching educational expectations. Earning an A,B, or C in an Honors Course is expected; AP Calculus BC is an honors course. Therefore, students who are not earning an A,B, or C will not be approved to go on Field Trips.
- Parents and students are strongly encouraged to use Skyward Family Access to be informed on students' progress.
- Parent Liaison Contact Information: Mr. Joshua Galvan 708-780-4000 ext. 2009 or JoshuaGalvan@jsmorton.org
- Students are expected to have the following materials:
    - Textbook: Calculus for the AP Course, Sullivan & Miranda https://achieve.bfwpub.com/courses/jxbmet
    - Binder: for notes, homework, quizzes, tests
    - Pencils & Erasers
    - Graphing Calculator (TI-Nspire CX or TI-Nspire CAS)

CLASS EXPECTATION

Learn as best as you can every minute of every day and encourage others to do the same.

Calculus BC

Functions, Graphs, and Limits

Standard	5	4	3	2	1	0
Find the limits of functions graphically, numerically, and analytically	Student can find limits accurately and justify with perfect notation.	Student can find limits accurately and justify.	Student can find limits accurately.	Student can find limits using all 3 methods.	Student can find the limit in 2 of the 3 methods.	Student makes no attempt or limited attempt to find a limit.
Understand the continuity of a function	With perfect notation, student finds left-handed limit, right-handed limit, and function value all with accuracy and justification.	Student finds left-handed limit, right-handed limit, and function value all with accuracy and justification.	Student finds left-handed and right-handed limits and function value accurately.	Student finds left-handed and right-handed limits and function value.	Student finds left-handed limit, right-handed limits or function value.	Student makes no attempt or limited attempt to find a limit.
Discuss one-sided limits	Student can find limits accurately and justify with perfect notation.	Student can find limits accurately and justify.	Student can find limits accurately.	Student can find limits using all 3 methods.	Student can find the limit in 2 of the 3 methods.	Student makes no attempt or limited attempt to find a limit.
Use limits to find limits at infinity and infinite limits	Student can find limits accurately and justify with perfect notation.	Student can find limits accurately and justify.	Student can find limits accurately.	Student can find limits using all 3 methods.	Student can find the limit in 2 of the 3 methods.	Student makes no attempt or limited attempt to find a limit.
Analyze planar curves including parametric, polar, and vector form	Student can analyze planar curves including parametric, polar and vector form accurately and justify with perfect notation.	Student can analyze planar curves including parametric, polar and vector form accurately and justify.	Student can analyze planar curves including parametric, polar and vector form accurately.	Student can analyze planar curves using all 3 forms.	Student can analyze planar curves in 2 of the 3 forms.	Student makes no attempt or limited attempt to analyze planar curves including parametric, polar, and vector form

Calculus BC

Differentiation

Standard	5	4	3	2	1	0
Use and apply the definition of the derivative	Student can find the derivative using the definition of the derivative accurately and justify with perfect notation.	Student can find the derivative using the definition of the derivative accurately and justify.	Student can find the derivative using the definition of the derivative accurately.	Student can find the derivative using the definition of the derivative.	Student can use the definition of the derivative.	Student makes no attempt or limited attempt to find the derivative using the definition of derivative.
Understand basic rules of differentiation, including trig, logarithmic, and exponential functions	Student can find the derivative using the basic rules of differentiation, including trig, logarithmic, and exponential functions accurately and justify with perfect notation.	Student can find the derivative using the basic rules of differentiation, including trig, logarithmic, and exponential functions accurately and justify.	Student can find the derivative using the basic rules of differentiation, including trig, logarithmic, and exponential functions accurately.	Student can find the derivative using the basic rules of differentiation, including trig, logarithmic, and exponential functions.	Student can use the basic rules of differentiation, including trig, logarithmic, or exponential functions.	Student makes no attempt or limited attempt to find the derivative using basic rules of differentiation, including trig, logarithmic, and exponential functions.
Apply the product, quotient, and chain rules to differentiate functions.	Student can apply the product, quotient, and chain rules to differentiate functions accurately and justify with perfect notation.	Student can apply the product, quotient, and chain rules to differentiate functions accurately and justify.	Student can apply the product, quotient, and chain rules to differentiate functions accurately.	Student can apply the product, quotient, and chain rules to differentiate functions.	Student can apply the product, quotient, or chain rules to differentiate functions.	Student makes no attempt or limited attempt to apply the product, quotient, or chain rules to differentiate functions.
Make connections between position, velocity, and acceleration	Student can make connections between position, velocity, and acceleration accurately and justify with perfect notation.	Student can make connections between position, velocity, and acceleration accurately and justify.	Student can make connections between position, velocity, and acceleration accurately.	Student can make connections between position, velocity, and acceleration.	Student can make connections between two of the following: position, velocity, and acceleration.	Student makes no attempt or limited attempt to connect position, velocity, and acceleration.
Understand the difference between instantaneous and average rate of change.	Student can understand the difference between instantaneous and average rate of change accurately and justify with perfect notation.	Student can understand the difference between instantaneous and average rate of change accurately and justify.	Student can understand the difference between instantaneous and average rate of change accurately.	Student can understand the difference between instantaneous and average rate of change.	Student can find instantaneous rate of change and average rate of change.	Student makes no attempt or limited attempt to understand the difference between instantaneous and average rate of change.
Analyze planar curves planar curves in parametric, polar, and vector form, including velocity and acceleration	Student can analyze planar curves in parametric, polar and vector form, including velocity and acceleration accurately and justify with perfect notation.	Student can analyze planar curves in parametric, polar and vector form, including velocity and acceleration accurately and justify.	Student can analyze planar curves in parametric, polar and vector form, including velocity and acceleration accurately.	Student can analyze planar curves using all 3 forms.	Student can analyze planar curves in 2 of the 3 orms.	Student makes no attempt or limited attempt to analyze planar curves in parametric, polar and vector form, including velocity and acceleration.

Apply rules of differentiation to implicit equations.	Student can apply rules of differentiation to implicit equations, including the product, quotient, and chain rules accurately and justify with perfect notation.	Student can apply rules of differentiation to implicit equations, including the product, quotient, and chain rules accurately and justify.	Student can apply rules of differentiation to implicit equations, including the product, quotient, and chain rules accurately.	Student can apply rules of differentiation to implicit equations, including the product, quotient, and chain rules.	Student can apply rules of differentiation to implicit equations.	Student makes no attempt or limited attempt to apply rules of differentiation to implicit equations.

Calculus BC

Applications of Derivatives

Standard	5	4	3	2	1	0
Understand the Extreme and Mean Value Theorems	Student uses correct notation, function values and perfect justification for both theorems.	Student uses correct function values and perfect justification for both theorems.	Student uses correct function values and justifies for both theorems.	Student can use the Extreme and Mean Value Theorems.	Student can use the Extreme or Mean Value Theorem.	Student attempts to use non-Calculus methods or no attempt.
Determine extrema and increasing/decreasing behavior of a function	Student perfectly identifies critical points to determine extrema and intervals of increasing/decreasing with correct notation.	Student uses critical points to determine extrema and intervals of increasing/decreasing with notation.	Student uses critical points to determine extrema and intervals of increasing/decreasing.	Student uses critical points to determine extrema or intervals of increasing/decreasing.	Student can find critical points and determine intervals.	Student attempts to use non-Calculus methods or no attempt.
Use the 2nd derivative test to determine extrema	Student can find limits accurately and justify with perfect notation.	Student can find limits accurately and justify.	Student can find limits accurately.	Student can find limits using all 3 methods.	Student can find the limit in 2 of the 3 methods.	Student makes no attempt or limited attempt to find a limit.
Use the 2nd derivative to determine concavity	Student can find limits accurately and justify with perfect notation.	Student can find limits accurately and justify.	Student can find limits accurately.	Student can find limits using all 3 methods.	Student can find the limit in 2 of the 3 methods.	Student makes no attempt or limited attempt to find a limit.
Solve optimization problems	Student accurately solves using the derivative with perfect explanation and units.	Student accurately solves using the derivative with perfect explanation.	Student accurately solves using the derivative.	Student finds the derivative accurately to attempt to solve.	Student finds the derivative to attempt to solve.	Student attempts to use non-Calculus methods or no attempt.
Calculate linear approximations	Student accurately calculates the equation of the tangent line and uses it to approximate with perfect notation and justification.	Student accurately calculates the equation of the tangent line and uses it to approximate with justification.	Student accurately calculates the equation of the tangent line and uses it to approximate.	Student accurately calculates the equation of the tangent line.	Student calculates the equation of the tangent line.	Student makes no or limited attempt.
Solve related rate problems	Student accurately solves using the derivative with perfect explanation and units.	Student accurately solves using the derivative with perfect explanation.	Student accurately solves using the derivative.	Student finds the derivative accurately to attempt to solve.	Student finds the derivative to attempt to solve.	Student attempts to use non-Calculus methods or no attempt.

Calculus BC

Definite Integrals

Standard	5	4	3	2	1	0
Calculate areas using the rectangular approximation methods.	Student can calculate areas using the left, right, and midpoint rectangular approximation methods accurately and justify with accurate notation.	Student can calculate areas using the left, right, and midpoint rectangular approximation methods accurately and justify.	Student can calculate areas using the left, right, and midpoint rectangular approximation methods accurately.	Student can calculate areas using the left, right, and midpoint rectangular approximation.	Student can calculate areas using the left and right rectangular approximation methods.	Student makes no attempt or limited attempt to calculate areas using the rectangular approximation methods
Use Riemann Sums with uneven subintervals.	Student can use left, right, and midpoint Riemann Sums with uneven subintervals accurately and justify with accurate notation.	Student can use left, right, and midpoint Riemann Sums with uneven subintervals accurately and justify.	Student can use left, right, and midpoint Riemann Sums with uneven subintervals accurately.	Student can use left, right, and midpoint Riemann Sums with uneven subintervals.	Student can use left and right Riemann Sums with uneven subintervals.	Student makes no attempt or limited attempt to use left and right Riemann Sums with uneven subintervals.
Use the definite integral as a limit of Riemann Sums.	Student can write and evaluate the definite integral as a limit of Riemann Sums accurately and justify with accurate notation.	Student can write and evaluate the definite integral as a limit of Riemann Sums accurately and justify.	Student can write and evaluate the definite integral as a limit of Riemann Sums accurately.	Student can write accurately and evaluate the definite integral as a limit of Riemann Sums.	Student can write and evaluate the definite integral as a limit of Riemann Sums.	Student makes no attempt or limited attempt to write and evaluate the definite integral as a limit of Riemann Sums.
Use technology to calculate the definite integral.	Student can use technology to calculate the definite integral, including trig functions, accurately and justify with accurate notation.	Student can use technology to calculate the definite integral, including trig functions, accurately and justify.	Student can use technology to calculate the definite integral, including trig functions, accurately.	Student can use technology to calculate the definite integral, including trig functions.	Student can use technology to calculate the definite integral.	Student makes no attempt or limited attempt to use technology to calculate the definite integral.
Understand the Mean Value Theorem for Integrals and Average Value Theorem	Student uses correct notation, function values and perfect justification for both theorems.	Student uses correct function values and perfect justification for both theorems.	Student uses correct function values and justifies for both theorems.	Student can use the Mean Value Theorem for Integrals and the Average Value Theorem.	Student can use the Mean Value Theorem for Integrals or the Average Value Theorem.	Student attempts to use non-Calculus methods or no attempt.
Understand basic rules of antidifferentiation, including trig, logarithmic, and exponential, parametric, polar and vector functions	Student can find the antiderivative using the basic rules of antidifferentiation, including trig, logarithmic, and exponential functions accurately and justify with perfect notation.	Student can find the antiderivative using the basic rules of antidifferentiation, including trig, logarithmic, and exponential functions accurately and justify.	Student can find the antiderivative using the basic rules of antidifferentiation, including trig, logarithmic, and exponential functions accurately.	Student can find the antiderivative using the basic rules of antidifferentiation, including trig, logarithmic, and exponential functions.	Student can use the basic rules of antidifferentiation, including trig, logarithmic, or exponential functions.	Student makes no attempt or limited attempt to find the antiderivative using basic rules of antidifferentiation, including trig, logarithmic, and exponential functions.

Apply the technique of substitution to antidifferentiate functions	Student can apply the technique of substitution to antidifferentiate functions accurately and justify with perfect notation.	Student can apply the technique of substitution to antidifferentiate functions accurately and justify.	Student can apply the technique of substitution to antidifferentiate functions accurately.	Student can apply the correct substitution and the technique of substitution to antidifferentiate functions.	Student can recognize the correct substitution needed to antidifferentiate functions.	Student makes no attempt or limited attempt to apply the product, quotient, or chain rules to differentiate functions.
Use the Fundamental Theorem of Calculus to find the derivative of an integral	Students uses the Fundamental Theorem of Calculus to find the derivative of an integral accurately and justify with perfect notation.	Students uses the Fundamental Theorem of Calculus to find the derivative of an integral accurately and justify.	Students uses the Fundamental Theorem of Calculus to find the derivative of an integral accurately.	Students can recognize that the derivative of an integral are inverse operations and uses the Fundamental Theorem of Calculus to find the derivative of an integral	Students can recognize that the derivative of an integral are inverse operations.	Students makes no attempt or limited attempt to use the Fundamental Theorem of Calculus to find the derivative of an integral
Use the definite integral as a limit of Trapezoid Sums	Student can use the definite integral as a limit of Trapezoid Sums accurately and justify with accurate notation.	Student can use the definite integral as a limit of Trapezoid Sums accurately and justify.	Student can use the definite integral as a limit of Trapezoid Sums accurately.	Student can use the definite integral as a limit of Trapezoid Sums.	Student can recognize the definite integral as a limit of Trapezoid Sums	Student makes no attempt or limited attempt to use the definite integral as a limit of Trapezoid Sums

Calculus BC

Differential Equations & Mathematical Modeling

Standard	5	4	3	2	1	0
Construct and analyze slope fields	Student can construct and analyze slope fields accurately and justify with accurate notation.	Student can construct and analyze slope fields accurately and justify.	Student can construct and analyze slope fields accurately.	Student can construct and analyze slope fields.	Student can construct or analyze slope fields	Student can construct and analyze slope fields accurately.
Determine numerical solutions of differential equations using Euler's method	Student can determine numerical solutions of differential equations using Euler's method accurately and justify with proper notation.	Student can determine numerical solutions of differential equations using Euler's method accurately and justify.	Student can determine numerical solutions of differential equations using Euler's method accurately.	Student can determine numerical solutions of differential equations using Euler's method.	Student can use numerical solutions of differential equations using Euler's method.	Student makes no attempt or limited attempt to determine numerical solutions of differential equations using Euler's method.
Solve separable differential equations	Student can solve separable differential equations accurately and justify with accurate notation.	Student can solve separable differential equations accurately and justify.	Student can solve separable differential equations accurately.	Student can separate and antiderive a separable differential equation.	Student can separate a separable differential equation.	Student makes no attempt or limited attempt to separate a separable differential equation
Apply differential equations to real-life problems	Student can apply differential equations to real-life problems accurately and justify with accurate notation.	Student can apply differential equations to real-life problems accurately and justify.	Student can apply differential equations to real-life problems accurately.	Student can separate and antiderive a separable differential equation in a real-life problem.	Student can separate a separable differential equation in a real-life problem.	Student makes no attempt or limited attempt apply differential equations to real-life problems accurately.

Calculus BC

Applications of Definite Integrals

Standard	5	4	3	2	1	0
Determine the area between curves and the area enclosed by intersecting curves with respect to x	Student can determine the area between curves and the area enclosed by intersecting curves with respect to x accurately and justify with accurate notation.	Student can determine the area between curves and the area enclosed by intersecting curves with respect to x accurately and justify.	Student can determine the area between curves and the area enclosed by intersecting curves with respect to x accurately.	Student can determine the area between curves and the area enclosed by intersecting curves with respect to x.	Student can recognize the area between curves and the area enclosed by intersecting curves with respect to x.	Student makes no attempt or limited attempt to determine the area between curves and the area enclosed by intersecting curves with respect to x.
Determine the area between curves and the area enclosed by intersecting curves with respect to y	Student can determine the area between curves and the area enclosed by intersecting curves with respect to y accurately and justify with accurate notation.	Student can determine the area between curves and the area enclosed by intersecting curves with respect to y accurately and justify.	Student can determine the area between curves and the area enclosed by intersecting curves with respect to y accurately.	Student can determine the area between curves and the area enclosed by intersecting curves with respect to y.	Student can recognize the area between curves and the area enclosed by intersecting curves with respect to y.	Student makes no attempt or limited attempt to determine the area between curves and the area enclosed by intersecting curves with respect to y.
Determine the area bounded by polar curves	Student can determine the area bounded by polar curves accurately and justify with proper notation.	Student can determine the area bounded by polar curves accurately and justify.	Student can determine the area bounded by polar curves accurately.	Student can determine the area bounded by polar curves.	Student can recognize the area bounded by polar curves	Student makes no attempt or limited attempt to determine the area bounded by polar curves.
Calculate the volume of a solid using Disk and Washer Method	Student can calculate the volume of a solid using Disk and Washer Methods accurately and justify with accurate notation.	Student can calculate the volume of a solid using Disk and Washer Methods accurately and justify.	Student can calculate the volume of a solid using Disk and Washer Methods accurately.	Student can calculate the volume of a solid using Disk and Washer Methods.	Student can calculate the volume of a solid using Disk or Washer Methods.	Student makes no attempt or limited attempt to calculate the volume of a solid using Disk or Washer Methods
Calculate the volume of a solid using Cross Sections	Student can calculate the volume of a solid using Cross Sections accurately and justify with accurate notation.	Student can calculate the volume of a solid using Cross Sections accurately and justify.	Student can calculate the volume of a solid using Cross Sections accurately.	Student can calculate the volume of a solid using Cross Sections.	Student can recognize the volume of a solid using Cross Sections	Student makes no attempt or limited attempt to calculate the volume of a solid using Cross Sections.
Find the length of a curve, including a curve given in parametric form	Student can find the length of a curve, including a curve given in parametric form accurately and justify with proper notation.	Student can find the length of a curve, including a curve given in parametric form accurately and justify.	Student can find the length of a curve, including a curve given in parametric form accurately.	Student can find the length of a curve, including a curve given in parametric form.	Student can find the length of a curve.	Student makes no attempt or limited attempt to find the length of a curve, including a curve given in parametric form.

Calculus BC

L'Hôpital's Rule and Improper Integrals

Standard	5	4	3	2	1	0
Apply L'Hôpital's Rule, including its use in determining limits and convergence of improper integrals and series	Students can apply L'Hôpital's Rule, including its use in determining limits and convergence of improper integrals and series accurately and justify with perfect notation.	Students can apply L'Hôpital's Rule, including its use in determining limits and convergence of improper integrals and series accurately and justify.	Students can apply L'Hôpital's Rule, including its use in determining limits and convergence of improper integrals and series accurately.	Students can apply L'Hôpital's Rule, including its use in determining limits and convergence of improper integrals and series.	Students can apply L'Hôpital's Rule.	Students make no attempt or limited attempt to apply L'Hôpital's Rule, including its use in determining limits and convergence of improper integrals and series.
Apply the technique of improper integrals as limits of definite integrals	Students can apply the technique of improper integrals as limits of definite integrals accurately and justify with perfect notation.	Students can apply the technique of improper integrals as limits of definite integrals accurately and justify.	Students can apply the technique of improper integrals as limits of definite integrals accurately.	Students can apply the technique of improper integrals as limits of definite integrals.	Students can recognize the technique of improper integrals as limits of definite integrals	Students make no attempt or limited attempt to apply the technique of improper integrals as limits of definite integrals.

Calculus BC

Infinite Series

Standard	5	4	3	2	1	0
Understand the concept of series as a sequence of partial sum as converging or diverging with motivating examples	Students can understand the concept of series as a sequence of partial sum as converging or diverging with motivating examples accurately and justify with perfect notation.	Students can understand the concept of series as a sequence of partial sum as converging or diverging with motivating examples accurately and justify.	Students can understand the concept of series as a sequence of partial sum as converging or diverging with motivating examples accurately.	Students can understand the concept of series as a sequence of partial sum as converging or diverging with motivating examples.	Students can recognize the concept of series as a sequence of partial sum as converging or diverging with motivating examples	Students make no attempt or limited attempt to understand the concept of series as a sequence of partial sum as converging or diverging with motivating examples.
Use Taylor polynomial approximation with graphical demonstration of convergence	Students can use Taylor polynomial approximation with graphical demonstration of convergence accurately and justify with perfect notation.	Students can use Taylor polynomial approximation with graphical demonstration of convergence accurately and justify.	Students can use Taylor polynomial approximation with graphical demonstration of convergence accurately.	Students can use Taylor polynomial approximation with graphical demonstration of convergence.	Students can recognize Taylor polynomial approximation with graphical demonstration of convergence.	Students make no attempt or limited attempt to use Taylor polynomial approximation with graphical demonstration of convergence.
Manipulate Taylor series centered at *x=a* including substitution, differentiation, antidifferentiation, and the formation of new series from known series	Students can manipulate Taylor series centered at *x=a* including substitution, differentiation, antidifferentiation, and the formation of new series from known series accurately and justify with perfect notation.	Students can manipulate Taylor series centered at *x=a* including substitution, differentiation, antidifferentiation, and the formation of new series from known series accurately and justify.	Students can manipulate Taylor series centered at *x=a* including substitution, differentiation, antidifferentiation, and the formation of new series from known series accurately.	Students can manipulate Taylor series centered at *x=a* including substitution, differentiation, antidifferentiation, and the formation of new series from known series.	Students can manipulate Taylor series centered at *x=a* including substitution, differentiation, antidifferentiation, or the formation of new series from known series.	Students make no attempt or limited attempt to manipulate Taylor series centered at *x=a* including substitution, differentiation, antidifferentiation, and the formation of new series from known series.
Identify and use the Maclaurin Series centered at *x=a* for the functions e^x, sin x, cos x and $\frac{1}{1-x}$	Students can identify and use the Maclaurin Series centered at *x=a* for the functions e^x, sin x, cos x and $\frac{1}{1-x}$ accurately and justify with proper notation.	Students can identify and use the Maclaurin Series centered at *x=a* for the functions e^x, sin x, cos x and $\frac{1}{1-x}$ accurately and justify.	Students can identify and use the Maclaurin Series centered at *x=a* for the functions e^x, sin x, cos x and $\frac{1}{1-x}$ accurately.	Students can identify and use the Maclaurin Series centered at *x=a* for the functions e^x, sin x, cos x and $\frac{1}{1-x}$.	Students can identify and use the Maclaurin Series centered at *x=a* for the functions e^x, sin x, cos x or $\frac{1}{1-x}$.	Students make no attempt or limited attempt to identify and use the Maclaurin Series centered at *x=a* for the functions e^x, sin x, cos x and $\frac{1}{1-x}$.
Use Lagrange error bound for Taylor polynomials	Students can use Lagrange error bound for Taylor polynomials accurately and justify with proper notation.	Students can use Lagrange error bound for Taylor polynomials accurately and justify.	Students can use Lagrange error bound for Taylor polynomials accurately.	Students can use Lagrange error bound for Taylor polynomials.	Students can recognize Lagrange error bound for Taylor polynomials.	Students make no attempt or limited attempt to use Lagrange error bound for Taylor polynomials.

Determine radius and interval of convergence of power series	Students can determine radius and interval of convergence of power series accurately and justify with proper notation.	Students can determine radius and interval of convergence of power series accurately and justify.	Students can determine radius and interval of convergence of power series accurately.	Students can determine radius and interval of convergence of power series.	Students can determine radius or interval of convergence of power series.	Students make no attempt or limited attempt to determine radius and interval of convergence of power series.
Understand the convergence of geometric, harmonic, and alternating series	Students can understand the convergence of geometric, harmonic, and alternating series accurately and justify with proper notation.	Students can understand the convergence of geometric, harmonic, and alternating series accurately and justify.	Students can understand the convergence of geometric, harmonic, and alternating series accurately.	Students can understand the convergence of geometric, harmonic, and alternating series.	Students can understand the convergence of geometric, harmonic, or alternating series.	Students make no attempt or limited attempt to understand the convergence of geometric, harmonic, and alternating series.
Determine the appropriate tests for convergence, including ratio, n^{th} term, integral, and comparison tests	Students can determine the appropriate tests for convergence, including ratio, n^{th} term, integral, and comparison tests accurately and justify with proper notation.	Students can determine the appropriate tests for convergence, including ratio, n^{th} term, integral, and comparison tests accurately and justify.	Students can determine the appropriate tests for convergence, including ratio, n^{th} term, integral, and comparison tests accurately.	Students can determine the appropriate tests for convergence, including ratio, n^{th} term, integral, and comparison tests	Students can determine the appropriate tests for convergence, including ratio, n^{th} term, integral, or comparison tests	Students make no attempt or limited attempt to determine the appropriate tests for convergence, including ratio, n^{th} term, integral, and comparison tests.