Title _____Honors Calculus_____

Unit:	**Limits**
Big Ideas:	CHA, LIM , FUN
Unit Essential Questions:	Can change occur at an instant? How does knowing the value of a limit, or that a limit does not exist, help you to make sense of interesting features of functions and their graphs? How do we close loopholes so that a conclusion about a function is always true?

Concept & Pacing	Pa Core Standard	Key Vocabulary	Essential Questions	Competencies (skills, knowledge, abilities)	Mini-Lessons/Activities	Instructional Materials	Assessments
Introduction 1 day		Rate of change Area under a curve	Can change occur at an instant?	Solving basic calculus problems using algebraic skills.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Quiz
2 Tangent Lines 3 days		Tangent Lines	How can graphs be used to determine rates of change?	Using a graphing device to find tangent lines to curves.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
3 Average and Instantaneous Rates of Change 3 days		Secant Lines AROC IROC Difference quotient Average Velocity Instantaneous Velocity	How are rates of change determined?	Calculate instantaneous and average rates of change.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
4 Graphical Approach to Limits 3 days		limit asymptote	How can reasoning with definitions and properties be used to justify claims about limits?	Determine the limits of functions using limit theorems. Interpret the behavior of functions using limits involving infinity.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
5 Algebraic Approach to Limits 3 days		indeterminate	How can reasoning with definitions and properties be used to justify claims about limits?	Determine the limits of functions using limit theorems. Interpret the behavior of functions using limits involving infinity.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
6-7 Definition of Derivative 4 days			How can reasoning with definitions and properties be used to justify claims about limits?	Represent the derivative of a function as the limit of a difference quotient. Determine the equation of a line tangent to a curve at a given point.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework
Review and Tests 6 days							

23 days

Title _____Honors Calculus_____

Unit:	**Differentiation: Definition, Fundamental Properties, Composite, Implicit, and Inverse Functions**
Big Ideas:	CHA, LIM, FUN
Unit Essential Questions:	Why do mathematical properties and rules for simplifying and evaluating limits apply to differentiation? What rules are used to determine derivatives?

Concept & Pacing	Pa Core Standard	Key Vocabulary	Essential Questions	Competencies (skills, knowledge, abilities)	Mini-Lessons/Activities	Instructional Materials	Assessments
8 Techniques of Differentiation 5 days		Constant Rule Single variable Rule Power Rule Constant Multiple Rule Sum/Difference Rule Product Rule Quotient Rule	What derivative rules should be applied in various situations?	Recognizing opportunities to apply derivative rules can simplify differentiation. Apply the concept of derivative to mathematical situations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
9 Chain Rule 3 days		Chain Rule	What derivative rules should be applied in various situations?	Recognizing opportunities to apply derivative rules can simplify differentiation. Apply the concept of derivative to mathematical situations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz Test
10 Differentiation of Trig Functions 3 days		Sine Cosine Tangent Cosecant Secant Cotangent	What derivative rules should be applied in various situations?	Recognizing opportunities to apply derivative rules can simplify differentiation. Apply the concept of derivative to mathematical situations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
11 Implicit Differentiation 3 days		Explicit Differentiation Implicit Differentiation	What derivative rules should be applied in various situations?	Recognizing opportunities to apply derivative rules can simplify differentiation. Apply the concept of derivative to mathematical situations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
12 Derivatives of Transcendental Functions 3 days		Transcendental Natural Log Logarithmic Differentiation Euler's Number	What derivative rules should be applied in various situations?	Recognizing opportunities to apply derivative rules can simplify differentiation. Apply the concept of derivative to mathematical situations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
13 Derivatives of Inverse Functions 3 days		Inverse Functions	What derivative rules should be applied in various situations?	Recognizing opportunities to apply derivative rules can simplify differentiation. Apply the concept of derivative to mathematical situations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework
14 Linear Approximations 3 days		Linear Approximation	How is the concept of derivative used to approximate values?	Derivatives allow us to solve real-world problems involving rates of change.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework
15 Continuity and Differentiability 3 days		Continuity of a Function Continuous Function	What definitions, theorems, and properties can be used	Justify conclusions about continuity at a point using the definition. Determine intervals over which a function is continuous.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz

		Step Discontinuity Removable Discontinuity Differentiability Cusp Corner	to justify claims about continuity?	Determine values of x or solve for parameters that make discontinuous functions continuous, if possible.			
Review and Tests 7 days							

33 days

Unit:	**Contextual and Analytical Applications of Differentiation**
Big Ideas:	CHA, LIM, FUN

Title _____Honors Calculus_____

Unit Essential Questions:	How can the application of mathematical theorems and properties help mathematical evaluations of equations and graphs? How can real-world situations be evaluated and solved through the application of Calculus principles?

Concept & Pacing	Pa Core Standard	Key Vocabulary	Essential Questions	Competencies (skills, knowledge, abilities)	Mini-Lessons/Activities	Instructional Materials	Assessments
16 Related Rates 3 days		Related Rates Law of Cosines	How can real-world situations be evaluated and solved through the application of Calculus principles?	Calculate related rates in applied contexts Interpret related rates in applied contexts.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
17 Straight-Line Motion 3 days		Position Velocity Functions Speed Acceleration Function Critical Time	How can real-world situations be evaluated and solved through the application of Calculus principles?	Interpret the meaning of a derivative in context. Calculate rates of change in applied contexts.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
18 Three Important Theorems 3 days		Intermediate-Value Theorem Rolle's Theorem Mean-Value Theorem	How can real-world situations be evaluated and solved through the application of Calculus principles?	Justify conclusions about functions by applying the IVT over an interval. Justify conclusions about functions by applying the Rolle's Theorem over an interval. Justify conclusions about functions by applying the MVT over an interval.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz Test
19 Function Analysis 3 days		Increasing Decreasing Constant Critical Value Stationary Point First Derivative Test Relative Minimum Relative Maximum Relative Extrema Concavity Inflection Point Stationary Inflection Point Second Derivative Test	How can the application of mathematical theorems and properties help mathematical evaluations of equations and graphs?	Justify conclusions about the behavior of a function based on the behavior of its derivatives.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz Test
20 Curve Sketching 3 days		Curve Sketching	How can the application of mathematical theorems and properties help mathematical evaluations of equations and graphs?	Justify conclusions about the behavior of a function based on the behavior of its derivatives.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz Test

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21 Absolute Extrema 3 days		Extreme Value Theorem Absolute Extrema	How can the application of mathematical theorems and properties help mathematical evaluations of equations and graphs?	Justify conclusions about functions by applying the EVT.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz Test
22 Optimization 3 days		Optimization	How can real-world situations be evaluated and solved through the application of Calculus principles?	Calculate minimum and maximum values in applied contexts or analysis of functions.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
23 Economic Optimization 3 days			How can real-world situations be evaluated and solved through the application of Calculus principles?	Calculate minimum and maximum values in applied contexts or analysis of functions.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test Project
24 Indeterminate Forms/L'Hopital's Rule 3 days		Indeterminate Form L'Hopital's Rule	How can the application of mathematical theorems and properties help mathematical evaluations of equations and graphs?	Determine limits of functions that result in indeterminate forms.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
Review and Tests Project 12 days							

39 days

Unit:	**Integration and Accumulation of Change**
Big Ideas:	CHA, LIM, FUN
Unit Essential Questions:	How can the application of geometric knowledge and mathematical rules be used to simplify integration?

Title _____Honors Calculus_____

Concept & Pacing	Pa Core Standard	Key Vocabulary	Essential Questions	Competencies (skills, knowledge, abilities)	Mini-Lessons/Activities	Instructional Materials	Assessments
25 Indefinite Integration 3 days		Anti-differentiation Integration Indefinite Integration Integral Sign Differential Equation General solution Initial Condition Specific solution	How can the application of geometric knowledge and mathematical rules be used to simplify integration?	Determine antiderivatives of functions and indefinite integrals, using knowledge about derivatives.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
26 u-Substitution 3 days		u-Substitution	How can the application of geometric knowledge and mathematical rules be used to simplify integration?	Determine indefinite integrals for integrands requiring substitution or rearrangements into equivalent forms.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
27 Definite Integrals 3 days		Definite Integral Integrand Limits of Integration	How can the application of geometric knowledge and mathematical rules be used to simplify integration?	Represent accumulation functions using definite integrals. Interpret the meaning of areas associated with the graph of a rate of change in context.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
28 The Accumulation Function 3 days		Accumulation Function	How can the application of geometric knowledge and mathematical rules be used to simplify integration?	Represent accumulation functions using definite integrals. Interpret the meaning of areas associated with the graph of a rate of change in context.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
29 Riemann Sums 3 days		Riemann Sums	How can the application of geometric knowledge and mathematical rules be used to simplify integration?	Interpret the limiting case of the Reimann sum as a definite integral. Represent the limiting case of the Reimann sum as a definite integral.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
30 The Fundamental Theorem of Calculus 3 days		Fundamental Theorem of Calculus	How can the application of geometric knowledge and mathematical rules be used to simplify integration?	Evaluate definite integrals analytically using the Fundamental Theorem of Calculus. Calculate a definite integral using areas and properties of definite integrals	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
31 Definite Integrals with u-Substitution 3 days		Changing the Limits	How can the application of geometric knowledge	Determine definite integrals for integrands requiring substitution or rearrangements into equivalent forms	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test

			and mathematical rules be used to simplify integration?	Calculate a definite integral using areas and properties of definite integrals			
32 Transcendental Functions and Integration 3 days			How can the application of geometric knowledge and mathematical rules be used to simplify integration?	Determine definite integrals for integrands requiring substitution or rearrangements into equivalent forms Calculate a definite integral using areas and properties of definite integrals	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
Review and Tests 9 days							

33 days

Unit:	**Applications of Integration**						
Big Ideas:	CHA						
Unit Essential Questions:	How do definite integrals allow us to solve problems involving the accumulation of change over an interval?						
Concept & Pacing	**Pa Core Standard**	**Key Vocabulary**	**Essential Questions**	**Competencies (skills, knowledge, abilities)**	**Mini-Lessons/Activities**	**Instructional Materials**	**Assessments**
33 Straight-Line Motion Revisited 3 days		Displacement Distance	How do definite integrals allow us to solve problems involving the accumulation of change over an interval?	Determine values for positions and rates of change using definite integrals in problems involving rectilinear motion.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
34 Average Value and Second FTC 3 days		Mean-Value Theorem of Integrals Average Value Second Fundamental Theorem of Calculus	How do definite integrals allow us to solve problems involving the accumulation of change over an interval?	Determine the average value of a function using definite integrals	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
35 Inverse Trig Functions 3 days			How can the application of geometric knowledge and mathematical	For integrands requiring integration with inverse trigonometric functions: determine indefinite integrals and evaluate definite integrals.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz

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			rules be used to simplify integration?				
36 Area of Region Between Two Curves 3 days			How do definite integrals allow us to solve problems involving the accumulation of change in area over an interval?	Calculate areas in the plane using definite integrals.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test Project
37 Volumes of Revolution 3 days		Disk Method Washer Method	How do definite integrals allow us to solve problems involving the accumulation of change in volume over an interval?	Calculate volumes of solids of revolution using definite integrals. Calculate volumes of solids with known cross sections using definite integrals.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test Project
38 Integration Applications 3 days			How do definite integrals allow us to solve problems involving the accumulation of change over an interval?	Apply various integration techniques and procedures to real-world situations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework
Review and Test Project 3 days							

26 days

Unit:	**Differential Equations**						
Big Ideas:	FUN						
Unit Essential Questions:	How can solving differential equations help in determining functions and developing models?						
Concept & Pacing	**Pa Core Standard**	**Key Vocabulary**	**Essential Questions**	**Competencies (skills, knowledge, abilities)**	**Mini-Lessons/Activities**	**Instructional Materials**	**Assessments**

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39 Slope Fields 3 days		Slope/Direction Field	How can solving differential equations help in determining functions and developing models?	Estimate solutions of differential equations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
40 Separable Differential Equations 3 days		Separable Differential Equations General Solution of DEQ Particular Solution Initial Condition	How can solving differential equations help in determining functions and developing models?	Determine general and particular solutions to differential equations.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Quiz
41 Exponential Growth 3 days		Exponential Growth Exponential Decay Half-life	How can solving differential equations help in determining functions and developing models?	Interpret the meaning of a differential equation and its context. Determine general and particular solutions for problems involving differential equations in context.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
42 Other Forms of Growth and Decay 3 days		Directly Proportional	How can solving differential equations help in determining functions and developing models?	Interpret the meaning of a differential equation and its context. Determine general and particular solutions for problems involving differential equations in context.	Lecture (video if needed) Example problems Practice Problems	Master Math Mentor packet Videos for lessons	Homework Test
Review and Tests 4 days							

16 days

Due to PA not having Calculus standard, the College Board AP Calculus AB format is used as a replacement.

College Board "Big Ideas"

1. **CHA Change-** Using derivatives to describe rates of change of one variable with respect to another or using definite integrals to describe the net change in one variable over an interval of another allows students to understand change in a variety of contexts. It is critical that students grasp the relationship between integration and differentiation as expressed in the Fundamental Theorem of Calculus.

2. **LIM Limits-** Beginning with a discrete model and then considering the consequences of a limiting case allows us to model real-world behavior and to discover and understand important ideas, definitions, formulas, and theorems in calculus.

3. **FUN Analysis of Functions-** 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.

Note: Above descriptions and verbage are from the **College Board** *Course and Exam Description* manual, and are copyrighted by said institution.