Pacing Guide - Calculus 12

Every September, teachers work hard to create a space that is safe and welcoming for all learners. The first weeks are a time to establish a sense of community, engage learners in rich interactive experiences to promote critical thinking and create opportunities for collaboration and discussion. This is an opportune time to develop a culture and a climate for mathematics learning, conducive to collaboration, risk taking and inquiry.

The following is a pacing guide for Mathematics at Work 10, which provides an overview of the units. It is a reference tool to support teachers with the timing of yearlong learning. Teachers are encouraged to use their professional judgment and consider the needs of their students when planning for instruction. For the purposes of planning your mathematics lessons, refer to the Calculus 12 curriculum document and the Calculus 12 Outcomes (2022) that provide essential background information and describe learning opportunities and assessment tasks for each of the outcomes in the unit.

Limits and Continuity (15-20 hours)

Derivatives (30-35 hours)

Applications of Derivatives (15-20 hours)

The Definite Integral and Its Applications (25-30 hours)

Note: The student text referred to is: Calculus: Graphical, Numerical, Algebraic, 2nd Ed., Finney (1999). MMBk4 refers to Mathematical Modeling, Book 4 from Nelson Education (2002).

Unit 1: Limits and Continuity

Timeline	GCO/SCO	Торіс	Resources
February	Limits and Continuity — B1 Calculate and interpret average and instantaneous rate of change. B2 Calculate limits for function values and apply limit properties with and without technology C1 identify the intervals upon which a given function is continuous and understanding the meaning of a continuous function B3 Remove removable discontinuities by extending or modifying a function B4 Apply the properties of algebraic combinations and composites of continuous functions A1 apply, understand and explain average and instantaneous rates of change an extend these concepts to secant lines and tangent line slopes C2 Understand the development of the slope of a tangent line from the slope of a secant line C3 Find the equations of the tangent and	Introduction to calculusCourse outline/formalizing norms etc.	 Develop classroom norms An overview of the big concepts from Calculus (Limits, Derivatives and Integrals). Review prerequisites for Calculus from student text Chap 1
		Introduction to limits Rates of change and limits	MMBk4: Investigation #4 "Closer and Closer" p.28 Curriculum Document: pp.2-9
		Continuity and piecewise functions	Student Text: Section 2.1 Curriculum Document: pp.10-15 Student Text: Section 2.3
		Rates of change, secant and tangent lines	Curriculum Document: pp.16-23 Student Text: Section 2.4
		Reinforcement, consolidation and assessment	Student Text: Chap 2 pp.91-93
		Approx. 19 hours	
	normal lines at a given point		

Unit 2: Derivatives

**Note: B10 and B12 (approximately 2 hours removed)

B10: Apply the rules for differentiating the six inverse trigonometry functions (optional)

B12: Apply Newton's method to approximate zeros of a function (optional)

Timeline	GCO/SCO	Торіс	Resources
March -April	Derivatives - A2 demonstrate an understanding of the definition of the derivative. C4 demonstrate an understanding of the connection between the graphs of f and f. B5 Find where a function is not differentiable and distinguish between corners, cusps, discontinuities, and vertical tangents. B6 Derive, apply, and explain power, sum, difference, product and quotient rules. B7 Apply the chain rule to composite functions B8 Use derivatives to analysis and solve problems involving rates of change. B9 Apply the rules for differentiating the six trigonometric functions A3 Demonstrate understanding of implicit differentiation and identify situations that require implicit differentiation B11 Calculate and apply derivatives of exponential and logarithmic functions B13 Estimate the change in a function using differentials and apply them to real world situations B14 Solve and interpret related rate problems	Building a conceptual understanding of the derivative including the definition of the derivative.	Curriculum Document: pp.26-31 Student Text: Section 3.1 MMBk4: Investigation #7 "Instantaneous Velocity" p89 and Investigation #8 "The Derivative" p95
		Differentiability Rules for differentiation (power, sum,	Curriculum Document: pp.32-35 Student Text: Section 3.2 Curriculum Document: pp.36-41
		The chain rule	Student Text: Section 3.3 Curriculum Document: pp.42-43 Student Text: Section 3.6 Postpone chain rule exercises dealing with trig until later. (select from questions: p.146 9, 12, 15, 16, 33, 34, 35, 37, 38)
		Implicit differentiation	Curriculum Document: pp.48-51 Student Text: Section 3.7
		Graphs of trig functions and reciprocal trig functions	MMBk4: Investigation #5 "Other Trigonometric Functions" p.233
		Derivatives of trig functions	Curriculum Document: pp.46-47 Student Text: Section 3.5 Revisit chain rule questions including trig from pp.146-147
		Determine, describe, and apply the value for "e"	MMBk4: Investigation #8 "Continuous Interest" p.183, Investigation #9 "Properties of y=e ^x " p.186, Investigation #10 "The Derivative of y=e ^x " p.187

	Derivatives of exponential and logarithmic functions	Curriculum Document: pp.54-55 Student Text: Section 3.9
	Velocity and other rates of change	Curriculum Document: pp.44-45 Student Text: Section 3.4
	Reinforcement, consolidation and assessment	Student Text: Chap 3 pp.172-175 Student Text: Chap 4 pp.242-245
	Approx. 37 hours	

Unit 3: Applications of Derivatives

Timeline	GCO/SCO	Торіс	Resources
April	Applications of Derivatives - B15 Demonstrate an understanding of critical points and absolute extreme values of a function B16 Find the intervals on which a function is increasing or decreasing C5 Apply the First and Second Derivative Tests to determine the local extreme values of a function C6 Determine the concavity of a function and locate the points of inflection by analyzing the second derivative B17 Solve application problems involving maximum or minimum values of a function	Critical points and absolute extreme values of functions	Curriculum Document: pp.66-67 Student Text: Section 4.1 MMBk4: Focus C End Behaviour and Oblique Asymptotes, Focus F Analysis of Rational Functions p.151
		Mean value theorem	Curriculum Document: pp.68-69 Student Text: Section 4.2
		Curve sketching. connecting f' and f" with the graph of f	Curriculum Document: pp.70-73 Student Text: Section 4.3
		Modeling and optimization	Curriculum Document: pp.74-75 Student Text: Section 4.4 Consider deriving the vertex formula using calculus as an introduction.
		Related rates	Curriculum Document: pp.60-63 Student Text: Section 4.6
		Reinforcement, consolidation and assessment	Student Text: Chap 4 pp.242-245
		Approx. 19 hours	•

Unit 4: The Definite Integral & Its Application

Timeline	GCO/SCO	Торіс	Resources
	The Definite Integral & Its	Sigma notation	MMBk4: Focus B More and More Minutes p.8
B4	Applications	Estimating a the area under a curve	Curriculum Document: pp.78-79
May -June	D1 Apply and understand how Riemann's sum	with finite sums (RAM)	Student Text: Section 5.1
345	can be used to determine the area under a polynomial curve D2 Demonstrate an understanding of the meaning of area under the curve D3 Express the area under the curve as a		http://www.intmath.com/integration/riemann-sums.php
		Definite integrals and Riemann sums	Curriculum Document: pp.80-81
			Student Text: Section 5.2
		Definite integrals and antiderivatives	Curriculum Document: pp.84-85
	definite integral D4 Compute the area under a curve using a		Student Text: Section 5.3
	numerical integration procedure	Fundamental theorem of calculus	Curriculum Document: pp.86-87
	C7 Solve initial value problems of the form		Student Text: Section 5.4
	$dy/dx = f(x), y_0 = f(x_0)$	Antiderivatives	Curriculum Document: pp.88-89
	B18 Apply rules for definite integrals B19 Apply the Fundamental Theorem of		Student Text: Section 6.1 (Omit slope fields, start on
	Calculus		p.306)
	C8 Understand the relationship between the		Student Text: Table 6.2 p.307
	derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus C9 Construct antiderivatives using the Fundamental Theorem of Calculus C10 Find antiderivatives of polynomials, e ^{kx} , and selected trigonometric functions of kx B20 Compute indefinite and definite integrals by the method of substitution B21 Apply integration by parts to evaluate indefinite and definite integrals (optional) B22 Solve problems in which a rate is integrated to find the net change over time D5 Apply integration to calculate areas of regions in a plane	Antidifferentiation by substitution	Curriculum Document: pp.90-91
			Student Text: Section 6.2
		Antidifferentiation by parts (optional)	Curriculum Document: pp.92-93
			Student Text: Section 6.3
		Initial value problems	Curriculum Document: pp.82-83
			Student Text: Section 6.1
		Integral as net change	Curriculum Document: pp.94-95
			Student Text: Section 7.1
		Areas in the plane	Curriculum Document: pp.96-99
			Student Text: Section 7.2
		Reinforcement, consolidation and	Student Text: Chap 5 pp.298-301
		assessment	Student Text: Chap 6 pp.358-361
			Student Text: Chap 7 pp.413-415
		Approx. 30 hours	

Outcome D6 (below) is optional and should be addressed if additional time is available at the end of the course. Refer to the curriculum document for additional information. Additionally, topics of Complex Numbers or Polar Coordinates/Functions could be added as optional topics.

D6 Apply integration (by slices or shells) to calculate volumes of solids **(optional)**