# Calculus 12

*Foundational Outcomes*

NOVA SCOTIA
NOUVELLE-ÉCOSSE

2020–2021

Website References

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Prepared by the Department of Education and Early Childhood Development

This is the most recent version of the current curriculum materials as used by teachers in Nova Scotia.

# Outcomes Framework Calculus 12 (2020-2021)

In September 2020, teachers will be working hard to create a space that is safe and welcoming for all learners no matter the location of their “classroom”. The first weeks will still be 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 **Foundational Outcomes** identified in this document represent outcomes determined to be relevant for future learning in mathematics. Decisions about foundational outcomes were made in consultation with teachers, provincial mathematics team, Board and Regional Centre staff. The foundational outcomes are meant to guide teachers in making decisions about creating learning experiences that will prepare and engage their learners in a responsive way. However, a teacher’s professional judgment remains the most important guide to effectively responding to the needs of their learners.

Colour coding has been used to identify outcomes as foundational (**green**), optional (**orange**) or non-foundational (**red**) for the 2020-2021 school year.

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| **A1** apply, understand, and explain average and instantaneous rates of change and extend these concepts to secant line and tangent line slopes. |
| **A2** demonstrate an understanding of the definition of the derivative |
| **A3** demonstrate an understanding of implicit differentiation and identify situations that require implicit differentiation |
| **B1** calculate and interpret average and instantaneous rate of change |
| **B2** calculate limits for function values and apply the properties with and without technology |
| **B3** remove removable discontinuities by extending or modifying a function |
| **B4** apply the properties of algebraic combinations and composites of continuous functions |
| **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 analyze and solve problems involving rates of change |
| **B9** apply the rules for differentiating the six trigonometric functions |

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| **B10 (optional)** apply the rules for differentiating the six<br>inverse trigonometric functions (recognition) |
| **B11** calculate and apply derivatives of exponential and logarithmic functions |
| **B12 (optional)** apply Newton's method to approximate zeros of a function |
| **B13** estimate the change in a function using differentials and apply them to real world situations |
| **B14** solve and interpret related rate problems |
| **B15** demonstrate an understanding of critical points and absolute e<br>xtreme values of a function |
| **B16** find the intervals on which a function is increasing or decreasing |
| **B17** solve application problems involving maximum or minimum values of a function |
| **B18** apply rules for definite integrals |
| **B19** apply the Fundamental Theorem of Calculus |
| **B20** compute indefinite and definite integrals by the method of substitution |
| **B21** (optional) apply integration by parts to evaluate indefinite and definite integrals |
| **B22** solve problems in which a rate is integrated to find the net change over time |
| **B23 (optional)** solve a differential equation of the form dy/dx = g(x)h(y), in which the variables are separable |
| **B24 (optional)** solve problems involving exponential growth and decay |
| **B25 (optional)** apply Euler's method to find approximate solutions to differential equations with initial values |
| **C1** identify the intervals upon with a given function is continuous and understand the meaning of a continuous function |
| **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 normal lines at a given point |
| **C4** Demonstrate an understanding of the connection between the graphs of f and f'. |
| **C5** apply the First and Second Derivative Tests to determine the local extreme values of a function |

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| **C6** determine the concavity of a function and locate the points of inflection by analyzing the second derivative |
| **C7** Solve initial value problems of the form dy/dx = f(x) , $y_0 = f(x_0)$, where f(x) is a function that students recognize as a derivative. |
| **C8** understand the relationship between the 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, ekx, and selected trigonometric functions of kx |
| **C11 (optional)** construct slope fields using technology and interpret them as visualizations of differential equations |
| **D1** apply and understand how Riemann's sum 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 definite integral |
| **D4** compute the area under the curve using numerical integration procedures |
| **D5** apply integration to calculate areas of regions in a plane |
| **D6 (optional)** apply integration (by slices or shells) to calculate volumes |