Carleton
UNIVERSITY

Carleton Mathematical Tutorial Series

Calculus Videos – Detailed Table of Contents

Differential Calculus

Video	Title	Topics	Length
1	Introduction	Four ways to study Calculus Pedagogical approach of the series Student optimal learning strategy Technology and Calculus	13 min
2	Why Calculus is Important	The importance of calculus in building dynamic mathematical models	15 min
3	Concept of a Derivative	Derivative is rate of change Simple epidemic model	13 min
4	Limits	Informal discussion of the key limits used in calculus Use of limits in modeling	14 min
5	Derivative	Formal definition and notations	13 min
6	Basic differentiation rules I	Linear and Product Rules Proof outline for product rule	18 min
7	Examples I	A series of examples that review the topics so far.	10 min
8	Basic rules of differentiation II	Chain Rule Proof outline for Chain Rule	13 min
9	Trigonometric functions I	Sine and cosine functions, graphs, derivatives Use of trig functions in modeling $\log_{h \to 0}(\sin h)/h$	18 min
10	Trigonometric functions II	Tangent and secant functions, definition, graphs, derivatives. Quotient Rule	13 min
11	Examples II	Examples of derivatives using trig functions and the differentiation rules Remarks on effective problem solving	14.5 min
12	Exponential Function	Exponential functions with base r. Derivative and the limit $\left(\lim_{h \to 0} \frac{r^h - 1}{h}\right)$ Definition of the number e and the function $e^x = \exp(x)$ Derivative calculation examples	20 min
13a	Logarithms (Properties)	Logarithm property Why we need logarithms: finance model Graphs and limits	10 min
13b	Logarithms (Derivatives)	Derivative of $\log x$ Examples of derivatives Working with other bases Bacterial growth model	15.5 min
14	Implicit differentiation	Implicit differentiation Geometric examples Logarithmic differentiation Example: Ideal Gas Law	19 min
15	Inverse trig functions: what and why	Inverse sin and tan functions Graphs and Derivatives of these functions	16 min
16a	Examples III	Examples using logs, exponentials and inverse trig functions (taken from old exams)	15 min
16b	Examples IV	Examples of Implicit Differentiation and analysis of a function	14 min

17	Summary of Differential Calculus	Ideas, techniques and key examples	11 min

Applications

App1	Newton's Method of Finding Roots	Introduction to Newton's iterative method Several examples including Newton's first Two special examples illustrating pathology	20 min
App2a	Exponential Models - I	Introduction to exponential models Unconstrained growth problems	20 min
App2b	Exponential Models - II	Use of half-life and doubling time Exponential models of radioactive decay	19 min
App2b	Exponential Models - III	Newton's Law of Cooling Financial examples	15 min
App3	L'Hospital's Rule	L'Hospital's Rule Examples Common Errors	20 min

Integral Calculus

1	Introduction	Three ways to look at Integral Calculus and why it is important	6.5 min
2	Numerical Integration	Using the Trapezoidal Method to approximate an integral Two examples	12.5 min
3	Numerical Integration – 2	Using the Trapezoidal Method to approximate the integral of a function	5.5 min
4	Fundamental Theorem of Calculus	Informal explanation of the FTOC	4.5 min
5	Anti-derivatives	Examples of anti-derivatives Review of FTOC Typical examples	9.5 min
6	Basic Anti-derivatives	Changing the key derivatives into the key anti-derivatives.	8.5 min
7	Indefinite Integrals	Review of FTOC and basic properties of definite integrals	4.5 min
8	Simple Anti-derivatives	Some simple integrals, Examples. Reductive strategy for integration	8.5 min
9	Integration by Substitution	Introduction to integration by substitution. Examples.	6.0 min
10	Examples of Substitution	Three examples. Definite integrals under substitution.	8.0 min
11	Examples of Strategic Substitution	Two examples of substitution of the form $x = g(u)$	7.0 min
12	More Examples of Substitution	Three examples including a definite integral.	7.0 min
13	The Importance of Substitution	The crucial role of substitution in integration. Includes an insider tip.	3.0 min
14	Integration and Differential Equations	Solution of a simple separable differential equation using integrals	7.5 min
15	Formulas and Guessing	Tables of Integrals, Formulas. Guess and check.	9.0 min
16	Integration by Parts - Method	Explanation of the formula illustrated by an example	6.5 min
17	Integration by Parts – Examples	Four examples of integration by parts	8.5 min

Special Topics

ST1	Proof of a Key Limit	Geometric proof of the limit $$\lim_{h \to 0} \frac{\sin h}{h} = 1$$	8 min

October 11, 2012