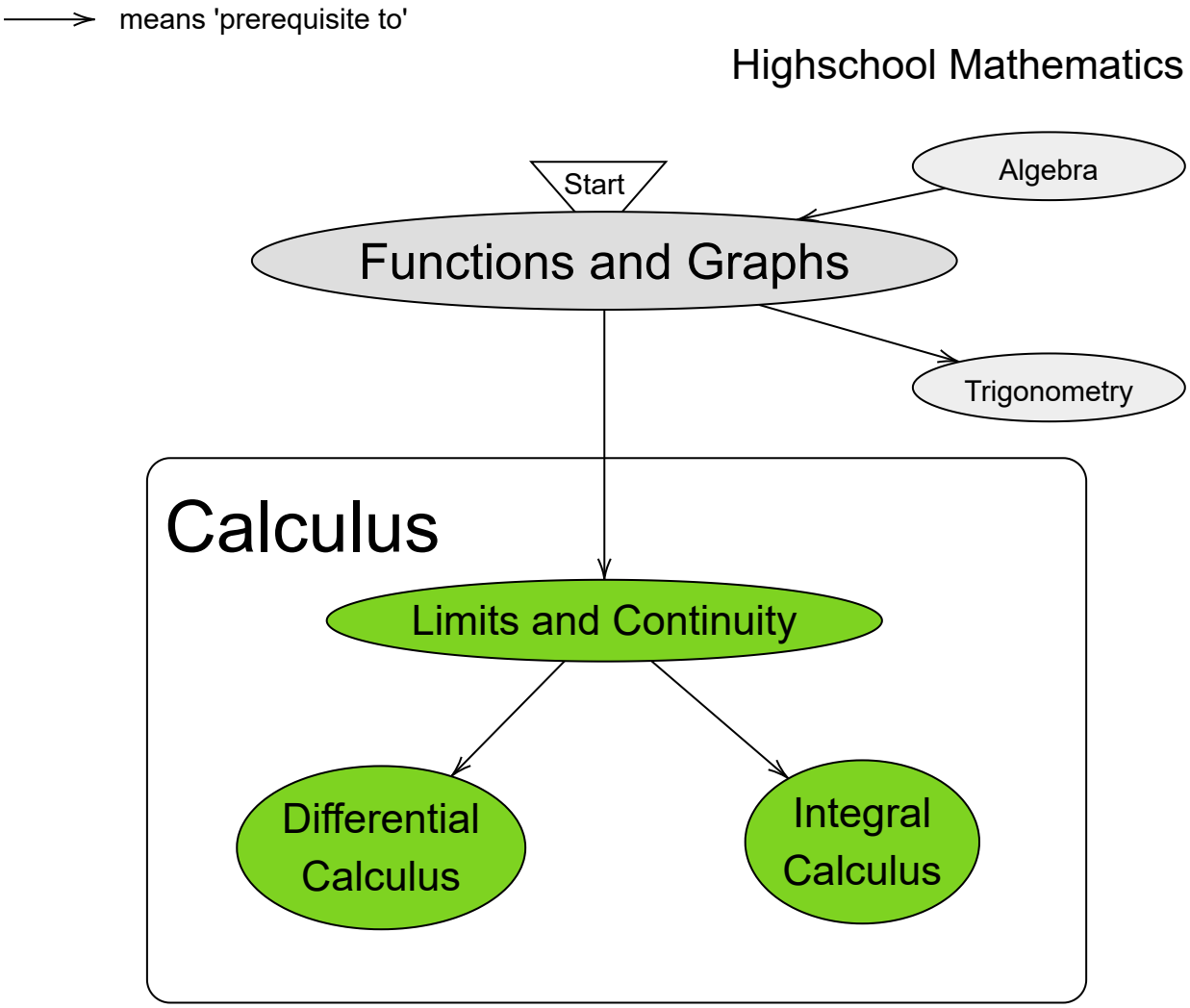
1. Map of Calculus

1.1. Flowchart



1.2. Lesson Plan

Lesson 1: Functions and Graphs

1) Definition of Function
2) Evaluating a Function
3) Graphing a Function
4) Main Types of Functions
5) Finding Domain and Range of a Function

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6) x-intercept and y-intercept
7) Operations on Functions
8) Symmetry of Functions
9) Inverse of a Function
10) Types of Functions
11) Graphical Translation of a Function
12) Analysis of Polynomial Functions
13) Analysis of Radical Functions
14) Analysis of Rational Functions

Lesson 2: Limits and Continuity

1) Informal Definition of a Limit
2) Graphical Approach to Limits of Functions
3) Properties and Formulas of Limits
4) One-sided Limits
5) Evaluation Techniques of Limits
6) Infinite Limits
7) Limits at Infinity
8) Continuity of a Function at a Number
9) Continuity of a Composite Function
10) Continuity on an Interval
11) Formal Definition of a Limit

Lesson 3: Differential Calculus

1) Definition of Derivative
2) Notation of Derivative
3) Differentiability vs Continuity
4) Derivatives of Algebraic Functions
5) Derivatives of Transcendental Functions
6) Chain Rule
7) Higher-order Derivatives
8) Implicit Differentiation

Lesson 4: Integral Calculus

1) Definition of Integrals
2) Notation of Integrals
3) Fundamental Theorems of Calculus
4) Indefinite Integrals
5) Definite Integrals
6) Integrals of Algebraic Functions
7) Integrals of Transcendental Functions
8) Techniques of Integration
    a) u-substitution
    b) Products and Some Quotients of Trigonometric Functions

b) Products and Some Quotients of Trigonometric Functions
c) Integration by Parts
d) Trigonometric Substitutions
e) Partial Fraction
9) Improper Integral
10) Approximating Definite Integrals

Lesson 5: Real-life Application

Differential Calculus
1) Slope of a Tangent Line
2) Rate of Change
3) Increasing and Decreasing Functions
4) Concavity and Points of Inflection
5) Marginal Analysis
6) Mean Value Theorem
7) Newton's Method
8) Related Rates
9) Optimization

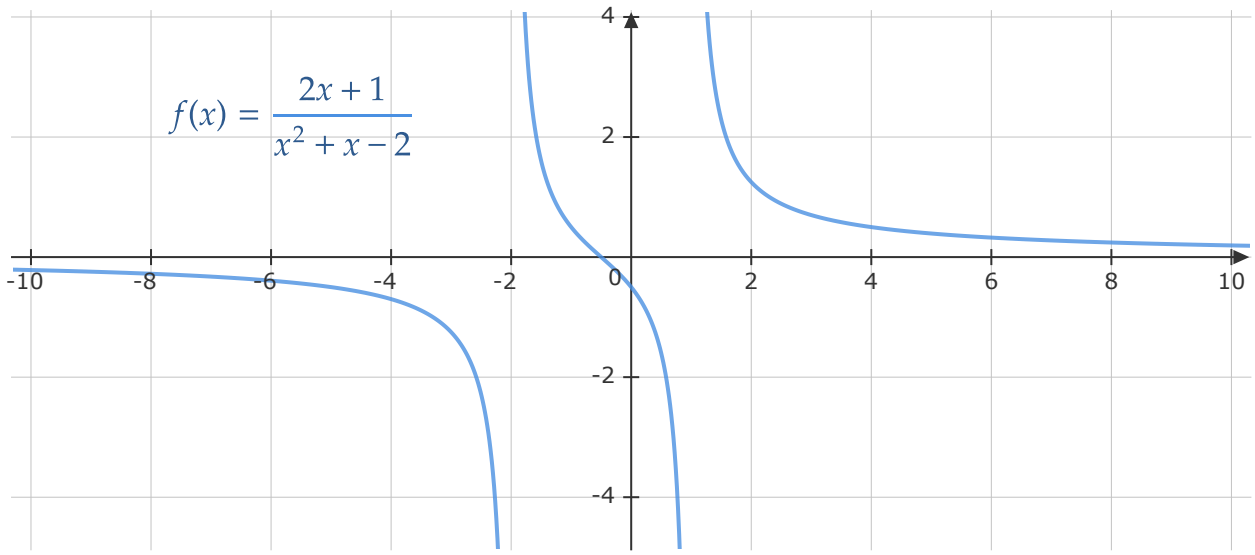
Integral Calculus
1) Net Area
2) Area Between Curves
3) Volumes of Revolution
4) Work
5) Average Function Value
6) Arc Length and Surface Area

2. Functions and Graphs

Function is the core prerequisite to calculus. It is the mathematical representation of an input x plugging it into a function f to produce an output $f(x)$.

A function value $f(x)$ tells the exact output value when pluging x as an input

2.1. Diagnostic Exercises



Exercise 1. Referencing to a graph above, evaluate the following:

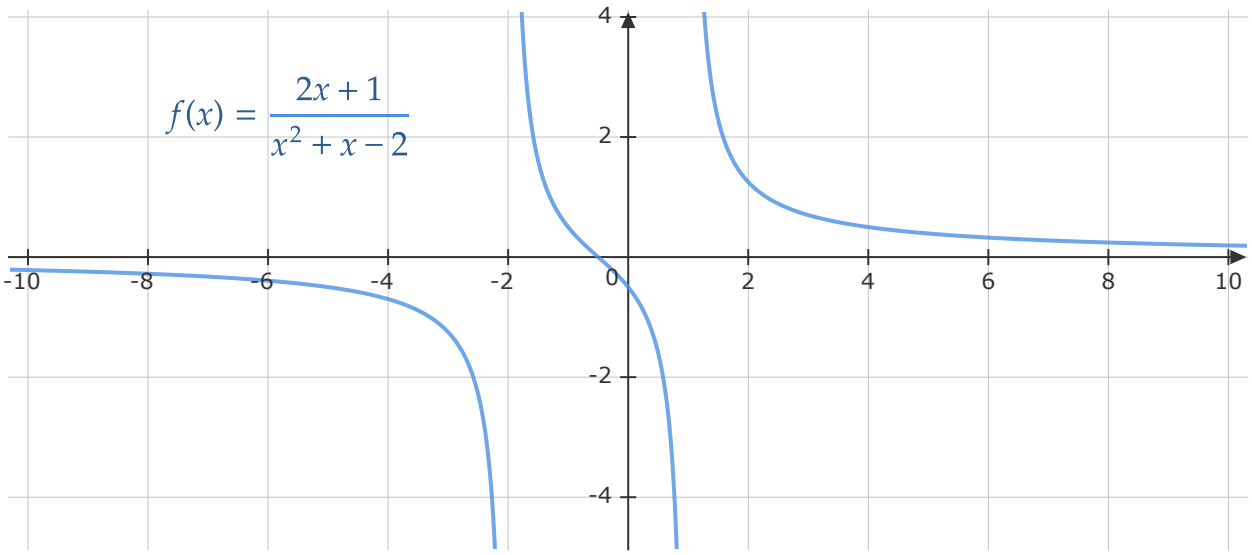
1) $f(4)$
2) $f1)$
3) $y - intercept$
4) $x - intercept$
5) Domain
6) Range
7) Horizontal asymptote/s
8) Vertical asymptote/s

Exercise 2. Using $f(x) = x^2 + 3$ and $g(x) = x - 1$ Evaluate the following:

1) $(f + g)(x)$
2) $(f \circ g)(2)$

3. Limits and Continuity

The limit of a function $\lim_{x \to a} f(x)$ tells what is the approaching output value to $f(a)$.



3.1. Diagnostic Exercises

Exercise 1. Referencing to a graph above, evaluate the following:

1) $\lim_{x \to 4} f(x)$
2) $\lim_{x \to 1^+} f(x)$
3) $\lim_{x \to 1^-} f(x)$
4) $\lim_{x \to 1} f(x)$
5) $\lim_{x \to 2^+} f(x)$
6) $\lim_{x \to 2^-} f(x)$
7) $\lim_{x \to 2} f(x)$
8) $\lim_{x \to \infty} f(x)$
9) $\lim_{x \to -\infty} f(x)$
10) Is the function $f(x)$ continuous at $x = 0$?

4. Differential Calculus

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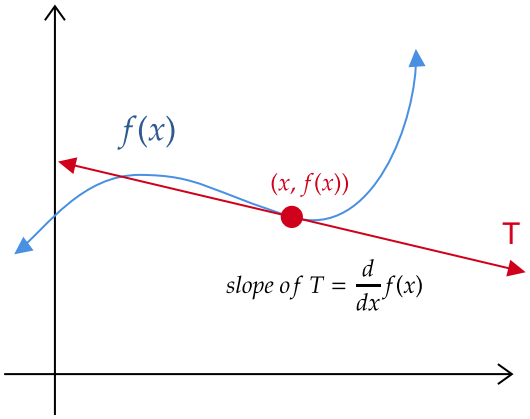
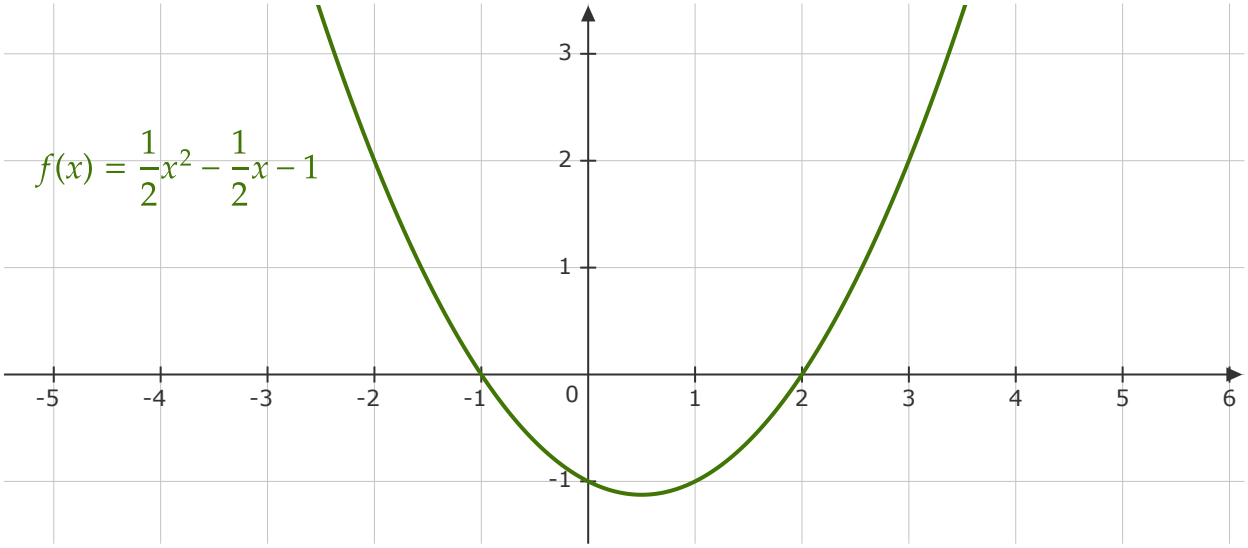
The derivative of a function $f(x)$ with respect to x, written as $\frac{d}{dx}f(x)$, produces the instantaneous rate of change of $f(x)$ as x changes. In a graphical approach, $\frac{d}{dx}f(x)$ is the slope of a function's tangent line T at any point $(x, f(x))$.



4.1. Diagnostic Exercises



Exercise 1. Referencing to a graph above, evaluate the following:

1) $\frac{d}{dx}f(x)$
2) $\frac{d}{dx}f(3)$

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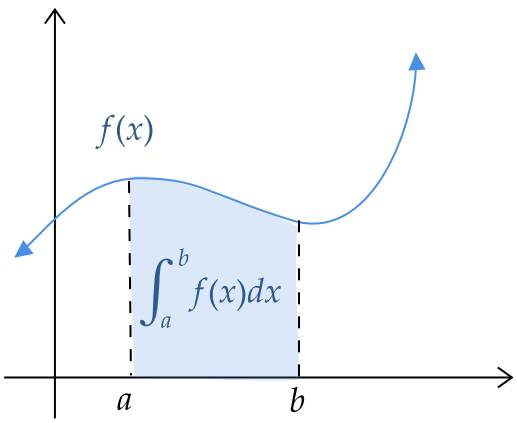
3) $\frac{d^2}{dx^2} f(3)$
4) $Minimum\ value\ of\ f(x)$

Exercise 2. Evaluate the following:

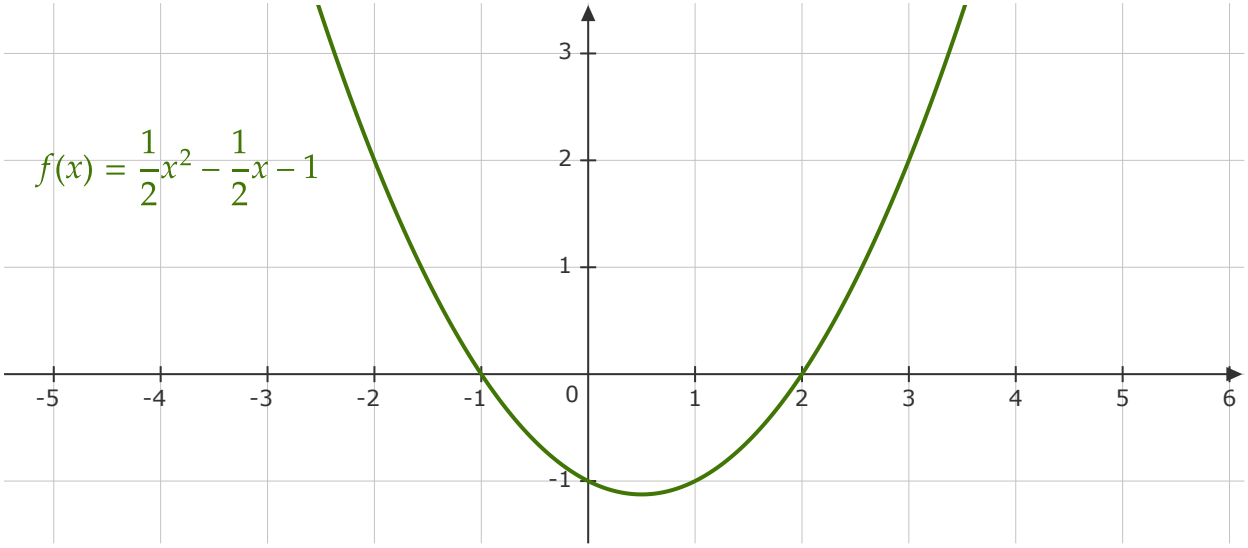
1) $\frac{d}{dx}[2\sin(x) + 3\tan(x)]$
2) $\frac{d}{dx}\left[3\left(x^3 - 2x + 1\right)^2 + x\right]$
3) $\frac{d^2}{dx^2}\left(4x^6 + 7x - 2\right)$
4) $\frac{d}{dx}\left[\left(x^2 - 2\right)(x + 3)\right]$
5) $\frac{d}{dx}\left(\frac{x+1}{x+2}\right)$
6) $\frac{d}{da}\left[3a^5 + 2y^2 + 4y\right]$

5. Integral Calculus

Integrating $f(x)$ with respect to its differential dx from left bound a to right bound b $(a < b)$, written as $\int_a^b f(x)dx$, produces $F(b) - F(a)$ where $F(x)$ is the antidifferentiation of $f(x)$. In a graphical approach, $\int_a^b f(x)dx$ is the accumulated area bounded by $f(x)$, $x = a$, $x = b$, and the $x - axis$.



5.1. Diagnostic Exercises



Exercise 1. Referencing to a graph above, evaluate the following:

1) $\int f(x)dx$
2) $\int_2^4 f(x)dx$
3) $\int_0^3 f(x)dx$
4) $\int_4^2 f(x)dx$

Exercise 2. Without using the graph, evaluate the following:

1) $\int \left[3\sin(u) + u^2\right]du$
2) $\int_{-7}^{-7} \left(x^2 + 3x + 1\right)dx$
3) If $f(x) = 2x^2 - 3$ and $g(x) = 5x - 2$, what is $\int [(f+g)(x)]dx$?
4) $\int (3x+2)^2 dx$
5) $\int \frac{1}{\left(x^2+5x\right)^7}dx$
6) $\int x^2\left(x^3-1\right)^4 dx$

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