OSDD - Calculus and Vector

MCV4U

Qinghao Hu

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Unit 1: Limits and the Derivative. The transition from average to instantaneous rates of change. Introduction to the limit operator, continuity, and the formal definition of the derivative from first principles.

Unit 2: Rules of Differentiation. Development of the algebraic machinery for differentiation. The Power, Product, Quotient, and Chain rules are applied to polynomials and rational functions to bypass the limit definition.

Unit 3: Derivatives of Transcendental Functions. Extension of differential calculus to non-algebraic functions. Analysis of the derivatives of sinusoidal, exponential, and logarithmic functions, including applications to composite functions.

Unit 4: Applications of Derivatives. Utilization of the derivative to solve real-world problems. Topics include velocity and acceleration in kinematics, related rates of change, and mathematical optimization problems.

Unit 5: Curve Sketching. A systematic approach to analyzing function behavior. Using the first and second derivatives to determine intervals of increase/decrease, concavity, points of inflection, and asymptotic behavior.

Unit 6: Introduction to Vectors. The shift from scalar to vector quantities. Geometric and algebraic representations of vectors in $\mathbb{R}^2$ and $\mathbb{R}^3$, including operations such as vector addition, scalar multiplication, and the dot and cross products.

Unit 7: Lines and Planes in $\mathbb{R}^3$. Analytic geometry in three-dimensional space. Derivation of vector, parametric, and Cartesian equations for lines and planes, and the analysis of their intersections and distances.

Contents

1 Slope

1.1 Measuring Rates of Change on a Table or a Graph

In Grade 9, we all studied the slope formula:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

m represents the slope because linear function is written as:

$$f(x) = mx + b$$

1.1.1 Intervial of the function

When you are asked to give the intervial of a function, one must response in one of these forms:

$$x \in (-\infty, a) \cap (b, \infty)$$

Example 1.1.

2 Reference Sheet

2.1 Assume Knowledge

2.1.1 Log Laws

$$\log_b A + \log_b B = \log_b(A \times B)$$
$$\log_b(\tfrac{M}{N}) = \log_b M - \log_b N$$
$$log_b M^k = k \log_b M$$
$$log_b b^k = k$$
$$b^{\log_b k} = k$$

2.1.2 Trig Laws

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$
$$\cot\theta = \frac{\cos\theta}{\sin\theta}$$
$$\csc\theta = \frac{1}{\sin\theta}$$
$$\sec\theta = \frac{1}{\cos\theta}$$
$$\sin^2\theta + \cos^2\theta = 1$$
$$1 + \cot^2\theta = \csc^2\theta$$
$$\tan^2\theta + 1 = \sec^2\theta$$
$$\sin(A \pm B) = \sin A \cos B \pm \sin B \cos A$$
$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$
$$\tan(\alpha \pm \beta) = \frac{\tan\alpha \pm \tan\beta}{1 \mp \tan\alpha \tan\beta}$$

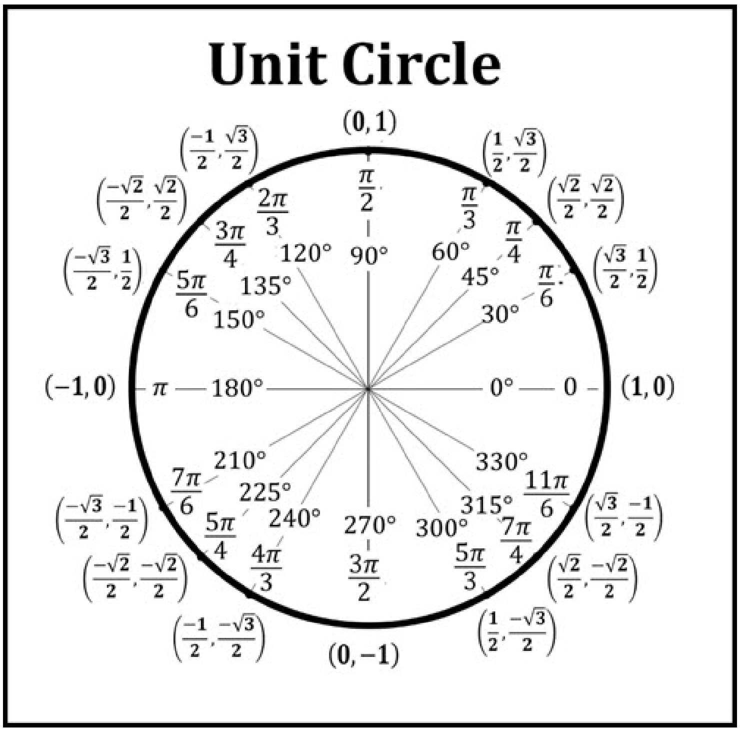
sin Law:

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

Cosine Law:

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Unit Circle:


Unit Circle
(0, 1)
(1, 0)
(0, −1)
(−1, 0)
0° 0
30° π/6 (√3/2, 1/2)
45° π/4 (√2/2, √2/2)
60° π/3 (1/2, √3/2)
90° π/2
120° 2π/3 (−1/2, √3/2)
135° 3π/4 (−√2/2, √2/2)
150° 5π/6 (−√3/2, 1/2)
180° π
210° 7π/6 (−√3/2, −1/2)
225° 5π/4 (−√2/2, −√2/2)
240° 4π/3 (−1/2, −√3/2)
270° 3π/2
300° 5π/3 (1/2, −√3/2)
315° 7π/4 (√2/2, −√2/2)
330° 11π/6 (√3/2, −1/2)