Derivative Test

First Derivative Test

- Tells us if the function is increasing or decreasing
- $f'(x) > 0$ function is increasing
- $f'(x) < 0$ function is decreasing

Critical Points

- f'(x) = 0 or f'(x) = Does not exists
- critical point is a local max if f'(x) changes from a + to -
- critical point is a local min if f'(x) changes from a - to +
- **Warning** Not all critical points are a max/min

Extrema

- To find the extremas in a closed intervals of a continuous function compare the function values at the endpoints and the critical points

Inflection

- Use the second derivative (f"(x)) to find inflection points
- Where the signs of f"(x) changes is your inflection

Concavity

- f is concave up when $f"(x) > 0$
- f is concave down when $f"(x) < 0$

Horizontal Asymptote

- f has horizontal asymptote at the horizontal line y = L (where $L \in \mathbb{R}$) if $\lim_{x\to\infty}$f(x) = L or $\lim_{x\to-\infty}$f(x) = L

Newton's Method

- to numerically find a solution to f(x) = 0, the method is $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$

Integrals a.k.a AntiDerivatives

Definition of Integral

- An integral of a function is the anti-derivative of it.

$$\int f(x)dx = F(x) + C \tag{1}$$

Caution If the integral is indefinite **(No specific bounds)** then write down the letter C.
Properties of the Integral

$$\int kf(x)dx = k\int f(x)dx \tag{2}$$

where k is any constant.

$$\int -f(x)dx = -\int f(x)dx \tag{3}$$

$$\int f(x) \pm g(x)dx = \int f(x)dx \pm \int g(x)dx \tag{4}$$

$$\int adx = ax + C \tag{5}$$

where a is a constant

$$\int x^n = \frac{x^{n+1}}{n+1} \tag{6}$$

Properties of Definite Integrals

Definite Integrals means an integral with a certain bounds. Written as $\int_a^b f(x)dx$ where f(x) represents a certain function and b and a represents the boundary areas.

$$\int_a^b f(x)dx = -\int_b^a f(x)dx \tag{7}$$

$$\int_a^a f(x)dx = 0 \tag{8}$$

$$\int_a^b f(x)dx \pm \int_b^c f(x)dx = \int_a^c f(x)dx \tag{9}$$

where a, b, and c represents a boundary point.

Trigonometry Integrals

- $\int sin(x)dx = -cos(x) + C$
- $\int cos(x)dx = sin(x) + C$
- $\int sec^2(x)dx = tan(x) + C$
- $\int csc^2(x)dx = cot(x) + C$
- $\int sec(x)tan(x)dx = sec(x) + C$
- $\int csc(x)cot(x)dx = -csc(x) + C$