| Trigonometric functions | know these ones well! | | | | | The angles or arcs x | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0° | 30° | 45° | 60° | 90° | 120° | 135° | 150° | 180° | 210° | 225° | 240° | 270° | 300° | 315° | 330° | 360° |
| | 0 | $\frac{\pi}{6}$ | $\frac{\pi}{4}$ | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $\frac{3\pi}{4}$ | $\frac{5\pi}{6}$ | $\pi$ | $\frac{7\pi}{6}$ | $\frac{5\pi}{4}$ | $\frac{4\pi}{3}$ | $\frac{3\pi}{2}$ | $\frac{5\pi}{3}$ | $\frac{7\pi}{4}$ | $\frac{11\pi}{6}$ | $2\pi$ |
| sin x | 0 | $\frac{1}{2}$ | $\frac{\sqrt{2}}{2}$ | $\frac{\sqrt{3}}{2}$ | 1 | $\frac{\sqrt{3}}{2}$ | $\frac{\sqrt{2}}{2}$ | $\frac{1}{2}$ | 0 | $-\frac{1}{2}$ | $-\frac{\sqrt{2}}{2}$ | $-\frac{\sqrt{3}}{2}$ | $-1$ | $-\frac{\sqrt{3}}{2}$ | $-\frac{\sqrt{2}}{2}$ | $-\frac{1}{2}$ | 0 |
| cos x | 1 | $\frac{\sqrt{3}}{2}$ | $\frac{\sqrt{2}}{2}$ | $\frac{1}{2}$ | 0 | $-\frac{1}{2}$ | $-\frac{\sqrt{2}}{2}$ | $-\frac{\sqrt{3}}{2}$ | $-1$ | $-\frac{\sqrt{3}}{2}$ | $-\frac{\sqrt{2}}{2}$ | $-\frac{1}{2}$ | 0 | $\frac{1}{2}$ | $\frac{\sqrt{2}}{2}$ | $\frac{\sqrt{3}}{2}$ | 1 |
| tan x | 0 | $\frac{\sqrt{3}}{3}$ | 1 | $\sqrt{3}$ | $\pm\infty$ | $-\sqrt{3}$ | $-1$ | $-\frac{\sqrt{3}}{3}$ | 0 | $\frac{\sqrt{3}}{3}$ | 1 | $\sqrt{3}$ | $\pm\infty$ | $-\sqrt{3}$ | $-1$ | $-\frac{\sqrt{3}}{3}$ | 0 |

$$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$$

$$f'(x) = \lim_{h\to 0} \frac{f(x) - f(a)}{x - a}$$

$$f'(x) = \lim_{h\to 0} \frac{f(a+h) - f(a)}{h}$$

- If a function f(x) is differentiable @ point *a*, then f(x) is continuous @ *a*
- If f(x) is not continuous @ point *a*, then f(x) is not differentiable @ *a*

- $\lim_{x\to 0} \frac{\sin(x)}{x} = 1$
- $\lim_{x\to 0} \frac{1-\cos(x)}{x} = 0$
- $\lim_{x\to 0} \frac{\tan(x)}{x} = 1$

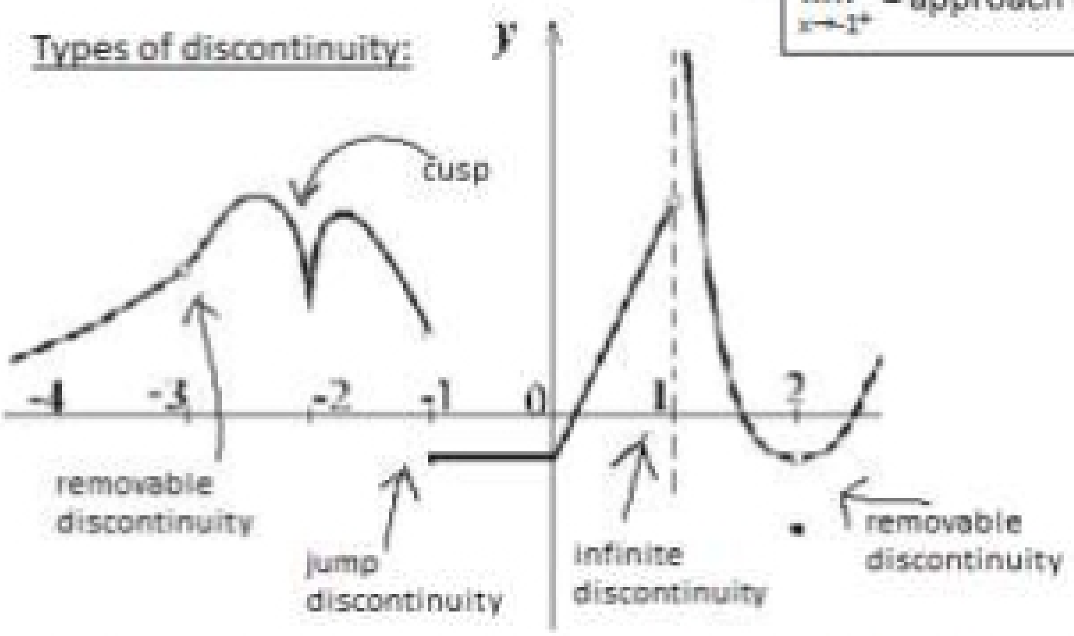
**Derivative:**
- aka instantaneous rate of change
- aka slope of tangent line

$\lim_{x\to 1^-}$ = approach from left

$\lim_{x\to 1^+}$ = approach from right

**Limit Laws:**
- $\lim_{x\to a} [f(x) + g(x)] = \lim_{x\to a} f(x) + \lim_{x\to a} g(x)$
- $\lim_{x\to a} [f(x) - g(x)] = \lim_{x\to a} f(x) - \lim_{x\to a} g(x)$
- $\lim_{x\to a} [cf(x)] = c \lim_{x\to a} f(x)$
- $\lim_{x\to a} [f(x)g(x)] = \lim_{x\to a} f(x) \bullet \lim_{x\to a} g(x)$
- $\lim_{x\to a} \frac{f(x)}{g(x)} = \frac{\lim_{x\to a} f(x)}{\lim_{x\to a} g(x)}$ if $\lim_{x\to a} g(x) \neq 0$

**Types of discontinuity:**




**Finding continuity of piecewise functions:**
- $f(x) = \begin{cases} x-2 & \text{if } x < 0 \\ x^2-2 & \text{if } x \geq 0 \end{cases}$

| f(x) = x-2 | $f(x) = x^2-2$ |
|---|---|
| f(0) = 0 -2 = -2 | $f(0) = 0^2-2 = -2$ |

-2 = -2 , therefore it is continuous at x=0

| |
|---|
| The limit of f(x) does NOT exist at -1 and 1 |
| The function f(x) is NOT continuous at -3, -1, 1, & 2 |
| The function f(x) is NOT differentiable at -2, -1, & 1 |

**Finding Limit of an Absolute Value:**

$\lim_{x\to -1} \frac{|x+1|}{x+1}$ ; $|x+1| = \begin{cases} x+1 & \text{if } x \geq -1 \\ -(x+1) & \text{if } x < -1 \end{cases}$

$\lim_{x\to -1^-} \frac{|x+1|}{x+1} = \lim_{x\to -1^-} \frac{x+1}{x+1}$

&

**Differentiation Rules:**
- $\frac{d}{dx}(x^n) = nx^{n-1}$
- $\frac{d}{dx}(c) = 0$
- $\frac{d}{dx}(x) = 1$
- $[f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$

**Derivatives of Trig Functions:**
- sin x = cos x
- $\tan x = \sec^2 x$
- sec x = sec x tan x