

# Formulas

Product Rule:  $f(x) = u(x)v(x)$

$$f'(x) = u'(x)v(x) + v'(x)u(x)$$

Quotient Rule:  $f(x) = \frac{u(x)}{v(x)}$

$$f'(x) = \frac{u'(x)v(x) - v'(x)u(x)}{v^2(x)}$$

Power Rule:  $f(x) = x^n$  where  $n$  is a #

$$f'(x) = nx^{n-1}$$

Tangent Line: 1) Find  $y'$

2) Plug  $x=c$  for  $y$ , and  $y'$ .

3) Plug values from (2) into

$$y - y(c) = y'(c)(x - c)$$

4) Solve for  $y$ .

## Derivatives of Trig Functions

$$\frac{d}{dx} [\sin x] = \cos x$$

$$\frac{d}{dx} [\cos x] = -\sin x$$

$$\frac{d}{dx} [\tan x] = \sec^2 x$$

$$\frac{d}{dx} [\cot x] = -\csc^2 x$$

$$\frac{d}{dx} [\sec x] = \sec x \tan x$$

$$\frac{d}{dx} [\csc x] = -\csc x \cot x$$

Derivative of  $e^x$  is  $e^x$ .

Continuity:  $\lim_{x \rightarrow c^-} f(x) = \lim_{x \rightarrow c^+} f(x) = f(c) = \lim_{x \rightarrow c} f(x)$

Limit doesn't exist (DNE) when  $\lim_{x \rightarrow c^-} f(x) \neq \lim_{x \rightarrow c^+} f(x)$

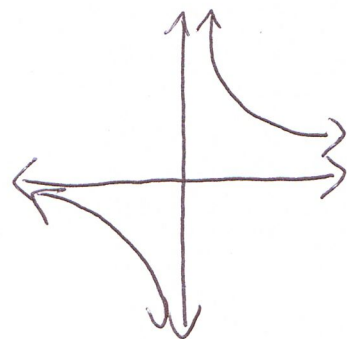
Ex:  $f(x) = \frac{1}{x}$

$$\lim_{x \rightarrow 0^-} \frac{1}{x} = -\infty$$

$$\lim_{x \rightarrow 0^+} \frac{1}{x} = \infty$$

$$\lim_{x \rightarrow 0} \frac{1}{x} \text{ DNE}$$

$f(0)$  undefined



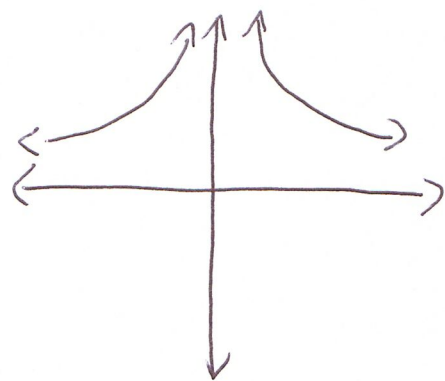
Ex:  $f(x) = \frac{1}{x^2}$

$$\lim_{x \rightarrow 0^-} \frac{1}{x^2} = \infty$$

$$\lim_{x \rightarrow 0^+} \frac{1}{x^2} = \infty$$

$$\lim_{x \rightarrow 0} \frac{1}{x^2} = \infty$$

$f(0)$  undefined



Rate of change is the derivative

~~Def~~ Limit Def of Derivative

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

Horizontal Tangent  
means the derivative is zero.

$$f'(x) = 0$$

- $(a \pm b)^2 = a^2 \pm 2ab + b^2$

- $x^{-m} = \frac{1}{x^m}$

- $a^2 - b^2 = (a+b)(a-b)$

- $\sqrt[q]{x^p} = x^{p/q}$

Trick to multiply terms

$$h(x) = (2x+1)(3x^2+2x+1) = 6x^3 + 7x^2 + 4x + 1$$

|      |        |        |      |
|------|--------|--------|------|
|      | $3x^2$ | $2x$   | $1$  |
| $2x$ | $6x^3$ | $4x^2$ | $2x$ |
| $1$  | $3x^2$ | $2x$   | $1$  |

$$\tan x = \frac{\sin x}{\cos x}$$

$$\csc x = \frac{1}{\sin x}$$

$$\cot x = \frac{\cos x}{\sin x}$$

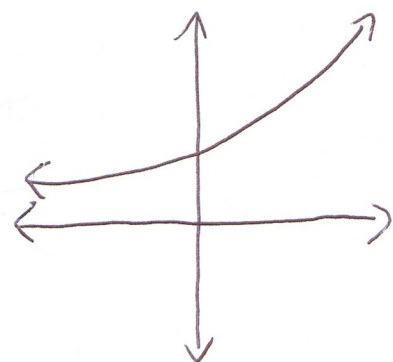
$$\sec x = \frac{1}{\cos x}$$

Remember

$$e^x > 0$$

Never!  $e^x \neq 0$

|        | $0$          | $\pi/6$      | $\pi/4$      | $\pi/3$      | $\pi/2$          |
|--------|--------------|--------------|--------------|--------------|------------------|
| $\sin$ | $0/2$        | $1/2$        | $\sqrt{2}/2$ | $\sqrt{3}/2$ | $\sqrt{4}/2 = 1$ |
| $\cos$ | $\sqrt{4}/2$ | $\sqrt{3}/2$ | $\sqrt{2}/2$ | $1/2$        | $0/2 = 0$        |



Vertical Asymptote vs. Hole

Hole when factors cancel out.  $f(x) = \frac{x^2(x-4)}{x-4}$

If no cancellation, then VA.  $f(x) = \frac{1}{x}$

Position / Velocity Function :  $v(t) = s(t)$