$$\lim_{x\to 0} x\cot 7x = \lim_{x\to 0} \frac{x\cos 7x}{\sin 7x}\cdot\frac{7}{7}$$

$$= \frac{1}{7}$$

1

$$\lim_{x\to 0}\frac{\sin x}{x} = 1$$

$$\lim_{x\to 0}\frac{\sin 7x}{7x} = 1$$

we only remember:

$$\frac{d}{dx}(e^x) = e^x$$

$$f(x) = a^x = e^{\ln a^{x}}$$

$$f(x) = e^{x\cdot\ln a}$$

$$f'(x) = e^{x\ln a}\cdot\ln a$$

$$= a^x \ln a$$

$$\frac{d(e^x)}{dx} = e^x$$

$$\frac{d(a^x)}{dx} = a^x\ln a$$

$$g(x) = e^{5x}$$

$$\rightarrow g'(x) = e^{5x}\cdot(5)$$

$$= 5e^{5x}$$

$$\frac{d}{dx}(e^x) = e^x$$

$$\frac{d(a^x)}{dx} = a^x \ln a$$

$$y = \ln x$$

$$\longleftrightarrow \quad e^y = x$$

$$e^y \frac{dy}{dx} = 1$$

$$\frac{dy}{dx} = \frac{1}{e^y}$$

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

$$y = \log_a x$$

$$\longleftrightarrow \quad a^y = x$$

$$a^y \ln a \frac{dy}{dx} = 1$$

$$\frac{dy}{dx} = \frac{1}{a^y \ln a}$$

$$= \frac{1}{x \ln a}$$

$$\frac{d(e^x)}{dx} = e^x$$

$$\frac{d(\ln x)}{dx} = \frac{1}{x}$$

$$\frac{d(a^x)}{dx} = a^x \ln a$$

$$\frac{d(\log_a x)}{dx} = \frac{1}{x \ln a}$$

$$\boxed{y = \sin^{-1} x}$$

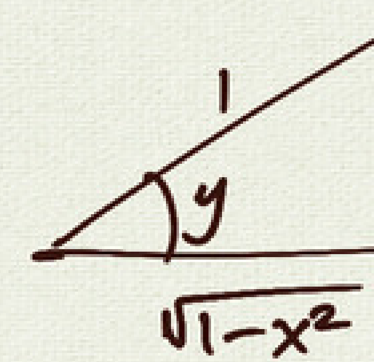
$$\Longleftrightarrow \sin y = x$$

$$\cos y \frac{dy}{dx} = 1$$

implicit diff.

$$\frac{dy}{dx} = \frac{1}{\cos y}$$

$$\boxed{\frac{dy}{dx} = \frac{1}{\sqrt{1-x^2}}}$$



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

reference triangle

Example:

$$g(x) = \sin^{-1}(x^2+3x)$$

$$\Longrightarrow g'(x) = \frac{1}{\sqrt{1-(x^2+3x)^2}} \cdot (2x+3)$$

$y = \tan^{-1} x$

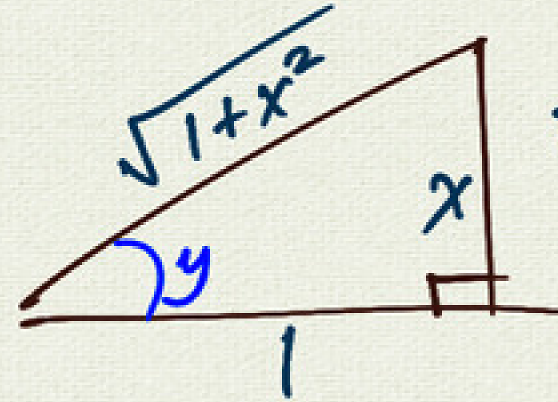
$\Longleftrightarrow \quad \tan y = x$

$\sec^2 y \frac{dy}{dx} = 1$

$\frac{dy}{dx} = \frac{1}{\sec^2 y}$

$= \cos^2 y$

$$\boxed{\frac{dy}{dx} = \frac{1}{1+x^2}}$$



$\tan y = \frac{x}{1}$

$\cos y = \frac{1}{\sqrt{1+x^2}}$

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example: $h(x) = \tan^{-1}(e^x + 2^x)$

$\Longrightarrow \quad h'(x) = \frac{1}{1+(\underbrace{e^x+2^x})^2} \cdot (e^x + 2^x \ln 2)$