#2 $x^2 \cdot e^x + e^x \cdot 2x$

$= x e^x (x+2)$

#3 $\dfrac{(x^3+1)(2x) - (x^2+1)(3x^2)}{(x^3+1)^2}$

$= \dfrac{2x^4 + 2x - 3x^4 - 3x^2}{(x^2+1)^2}$

$= \dfrac{-x^4 - 3x^2 + 2x}{(x^2+1)^2}$

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

#4 $f(x) = \sin(\underline{\cos x})$ chain rule

$$f'(x) = \cos(\cos x) \cdot (-\sin x)$$

↑

<u>NOT</u> $\cos x \cdot \cos x$

#5. $2 \tan x \cdot \sec^2 x$

#6 $f(x) = (x^2 + 3x + 1)^{1/2}$

$$f'(x) = \frac{1}{2}(x^2 + 3x + 1)^{-1/2}(2x+3)$$

$$= \frac{2x+3}{2\sqrt{x^2+3x+1}}$$

#1. $2x - 5xy' - 5y + 4yy' = 0$

$$y' = \frac{5y - 2x}{4y - 5x}$$

#2. $2x + 2yy' = \frac{(x-y)(1+y') - (x+y)(1-y')}{(x-y)^2}$

$$2x(x-y)^2 + \underline{2yy'(x-y)^2} = x + xy' - y - yy'$$

$$-x + xy' - y + yy'$$

$$= 2xy' - 2y$$

$$\boxed{y' = \frac{-2y - 2x(x-y)^2}{2y(x-y)^2 - 2x}}$$

$$= \frac{-y - x(x-y)^2}{y(x-y)^2 - 2x}$$

#3 $\underline{x \cdot \cos y \cdot y'} + \sin y = y \sin x + \underline{\cos x \cdot y'}$

$= \underline{2yy'}$

$$\boxed{y' = \frac{y \sin x - \sin y}{x \cos y + \cos x - 2y}}$$

#4 $\underline{e^y \cdot y'} - \underline{xy'} - y = \underline{x\,2yy'} + y^2$

$$\boxed{y' = \frac{y^2 + y}{e^y - x - 2xy}}$$

Other derivative formulas

- If $\underbrace{y = \ln x}_{\text{exponentiate to get}}$, find $\frac{dy}{dx}$.

$$e^y = e^{\ln x}$$

$$e^y = x \leftarrow \text{Now, differentiate implicitly}$$

$$\frac{d}{dx}\left[e^y\right] = \frac{d}{dx}\left[x\right]$$

$$e^y \cdot y' = 1$$

$$y' = \frac{1}{e^y} = \frac{1}{e^{\ln x}}$$

$$\boxed{y' = \frac{1}{x}}$$

Ex. $f(x) = \ln(x^2 + x)$ Find $f'(x)$

$$f'(x) = \frac{1}{x^2 + x} \cdot (2x+1) = \frac{2x+1}{x^2+x}$$

• If $y = \sin^{-1} x$, find $\frac{dy}{dx}$

Take the sine of both sides

$\sin y = x$ differentiate implicitly

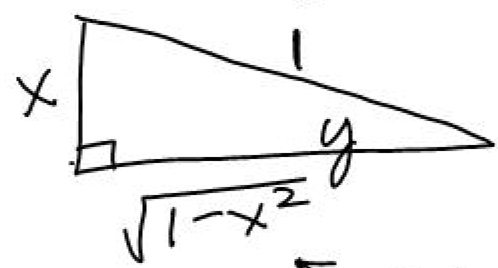
$$\frac{d}{dx}[\sin y] = \frac{d}{dx}[x]$$

$$\cos y \cdot y' = 1$$

$$y' = \frac{1}{\cos y}$$

$$\boxed{y' = \frac{1}{\sqrt{1-x^2}}}$$

$\sin y = x$



Pythag. Thm.

$y = \sqrt{1-x^2}$

$y^2 = 1 - x^2$

$x^2 + y^2 = 1$

• If $y = \cos^{-1} x$

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

• If $y = \tan^{-1} x$

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

Ex. $f(x) = \sin^{-1}\left(\frac{1}{x}\right)$ Find $f'(x)$

$$f'(x) = \frac{1}{\sqrt{1-\left(\frac{1}{x}\right)^2}} \cdot \frac{-1}{x^2}$$

deriv of $\frac{1}{x}$

$$= \frac{1}{\sqrt{\frac{x^2-1}{x^2}}} \cdot \frac{-1}{x^2}$$

$$= \frac{1}{\frac{\sqrt{x^2-1}}{|x|}} \cdot \frac{-1}{x^2}$$

$$= \frac{-|x|}{x^2\sqrt{x^2-1}}$$

HW
implict
#5, 6
logs + inv.
#1-6

$\sqrt{(-5)^2} = \sqrt{25} = 5$

$|-5|$

$y = \sqrt{x}$