Unit 10 : 1A Spring 2021

(A) $\sin(\log x)$

(B) e^{-x^2}

(C) $e^{\log x} = x$

(D) $\sqrt{x^2+4}$

(E) $\sin(\cos(x^2))$

(A) $\frac{\cos(\log x)}{x}$ (B) $-2x\,e^{-x^2}$

(C) 1, $\frac{e^{\log x}}{x}$ $\frac{1}{x}$ (D) $\frac{x}{\sqrt{x^2+4}}$

(E) $-2x\sin(x^2)\cos(\cos x^2)$

$$\frac{d}{dx} f(g(h(x))) = f'(g(h(x)))\,g'(h(x))\,h'(x)$$

$$\frac{d}{dx}(x^3)^5 = \frac{d}{dx}x^{15}$$

$$5(x^3)^4 \cdot 3x^2$$

$$= 15x^{12+2} = 15x^{14}$$

HW: $\frac{d}{dx} x^{1/4}$

$= \frac{1}{4} x^{-3/4}$

$\frac{d}{dx}\left(x^{1/4}\right)^4 = \frac{d}{dx} x = 1$

$4 \cdot \left(x^{1/4}\right)^3 \frac{d}{dx} x^{1/4}$

$\frac{d}{dx} x^{1/4} = \frac{1}{4x^{3/4}}$

challenge

$\frac{d}{dx}$ Sin cos exp tan x

Answer

$$\cos(\cos\exp\tan x)\cdot(-\sin(\exp\tan x))\cdot\exp\tan x\cdot\frac{1}{\cos^2 x}$$

- **Important:** inverse functions

$$\frac{d}{dx}\arcsin x = ?$$

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

Use the chain rule: ?

$$\cos(\arcsin x)\cdot\arcsin'(x) = 1$$

$$\arcsin'(x) = \frac{1}{\cos(\arcsin x)}$$

$$\cos^2 u + \sin^2 u = 1$$
$$\cos u = \sqrt{1-\sin^2 u}$$

$$= \frac{1}{\sqrt{1-\sin^2(\arcsin x)}}$$

$$\sin^2(\arcsin x) = \sin(\arcsin x) \cdot \sin(\arcsin x) = x^2$$

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

$$\frac{d}{dx} \arcsin x = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx} \log x$$

Assume we forgot.

What do we "do"?

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

$$\exp(\log x)\,\log'(x) = 1$$

$$\log'(x) = \frac{1}{\exp(\log x)} = \frac{1}{x}$$

- Remark!

Aways write

$\arcsin x$

and not

~~$\sin^{-1} x$~~

because $\sin^{-1}(x)$

can be confused

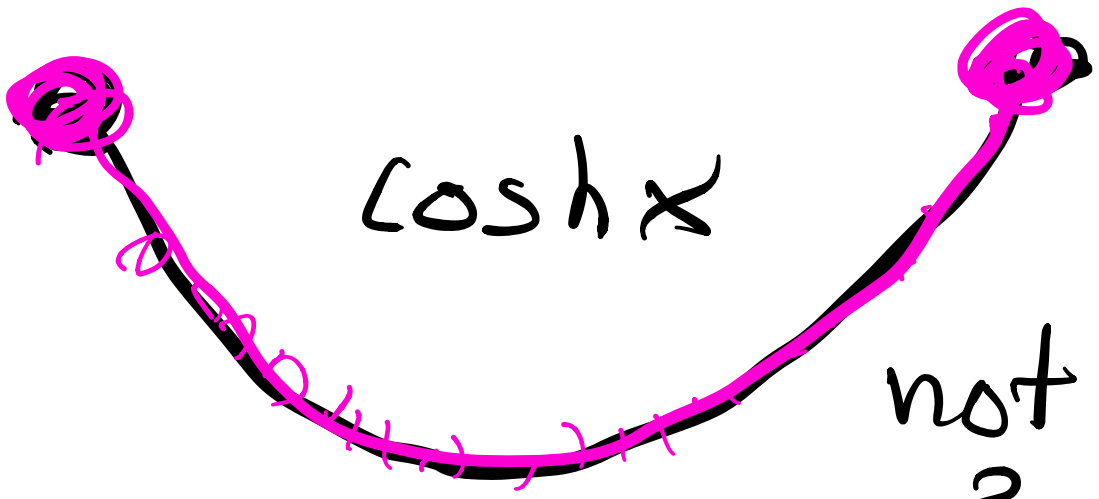
with $\frac{1}{\sin(x)}$

$$\sin^2(x) = (\sin(x))^2$$

- In the homework you deal with

$$\cosh x = \frac{e^x + e^{-x}}{2}$$

$$\sinh x = \frac{e^x - e^{-x}}{2}$$



Chain not x^2

$\frac{d}{dx}$ arctan x

(A) tan arctan x = x

(B) $\frac{d}{dx}$ tan arctan x = 1

$$\frac{1}{\cos^2(\arctan x)} \cdot \arctan'(x) = 1$$

(C) simplify using trig identities.

$$\frac{\cos^2(x)}{\cos^2 x} + \frac{\sin^2}{\cos^2 x} = \frac{1}{\cos^2 x}$$

$$1 + \tan^2 u = \frac{1}{\cos^2 u}$$

From (B)

$$\arctan'(x) = \cos^2(\arctan x)$$

$$= \frac{1}{1 + \tan^2(\arctan x)}$$

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

$$\tan \arctan x = x$$

$$\tan^2(\arctan x) = x^2$$

$$\frac{d}{dx} \arctan x = \frac{1}{1+x^2}$$

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