WARMUP

What if we continued the Fibonacci sequence backwards? What are the numbers that go in the spaces?

$\underline{-8}, \underline{5}, \underline{-3}, \underline{2}, \underline{-1}, \underline{1}, \underline{0}, 1, 1, 2, 3, 5, 8, 13, \ldots$

Section 3.6 Derivative of $\ln x$

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

$$\frac{d}{dx}\left(\ln f(x)\right) = \frac{1}{f(x)} \cdot f'(x) = \frac{f'(x)}{f(x)}$$

$\frac{d}{dx}\left(\ln\left(f(x)\right)\right)$

ex: $$\frac{d}{dx}\left(\ln\left(\cos x\right)\right) = \frac{\overbrace{-\sin x}^{f'(x)}}{\underbrace{\cos x}_{f(x)}} = -\tan x$$

ex: $$h(x) = \underbrace{x^3}_{1st}\underbrace{\ln(10x)}_{2nd}$$

$$h'(x) = \underbrace{x^3 \cdot \frac{\overset{f'(x)}{\cancel{10}} 1}{\underset{f(x)}{\cancel{10}x}}}_{} + \ln(10x) \cdot 3x^2$$

$$h'(x) = x^2 + 3x^2 \ln(10x)$$

$$h'(x) = x^2(1 + 3\ln(10x))$$

<u>ex</u>: $f(x) = e^{\ln(e^{2x^2+3})} = e^{2x^2+3}$

$$\frac{d}{dx}[e^{f(x)}] = e^{f(x)} \cdot f'(x)$$

$$f'(x) = e^{2x^2+3} \cdot 4x$$

$$\ln e^N = N$$

$$e^{\ln M} = M$$

$$f'(x) = 4xe^{2x^2+3}$$

<u>ex</u>: $f(x) = \frac{\ln x}{\sin x}$

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

$$f'(x) = \frac{\cancel{x} \cdot \sin x \cdot \frac{1}{\cancel{x}} - x \cdot \ln x \cdot \cos x}{x(\sin x)^2}$$

$$f'(x) = \frac{\sin x - x\ln x \cdot \cos x}{x\sin^2 x}$$

1. POWER: $\frac{d}{dx}\left[x^n\right] = nx^{n-1}$ $\frac{d}{dx}\left[(f(x))^n\right] = n(f(x))^{n-1} \cdot f'(x)$

2. e: $\frac{d}{dx}\left[e^x\right] = e^x$ $\frac{d}{dx}\left[e^{f(x)}\right] = e^{f(x)} \cdot f'(x)$

3. Exponential: $\frac{d}{dx}\left[a^x\right] = a^x \cdot \ln a$ $\frac{d}{dx}\left[a^{f(x)}\right] = a^{f(x)} \cdot \ln a \cdot f'(x)$

4. TRIGS:

A. $\frac{d}{dx}\left[\sin x\right] = \cos x$ $\frac{d}{dx}\left[\sin(f(x))\right] = \cos(f(x)) \cdot f'(x)$

B. $\frac{d}{dx}\left[\cos x\right] = -\sin x$ $\frac{d}{dx}\left[\cos(f(x))\right] = -\sin(f(x)) \cdot f'(x)$

C. $\frac{d}{dx}\left[\tan x\right] = \sec^2 x$ $\frac{d}{dx}\left[\tan(f(x))\right] = \sec^2(f(x)) \cdot f'(x)$

5. Natural Log: $\frac{d}{dx}\left[\ln x\right] = \frac{1}{x}$ $\frac{d}{dx}\left[\ln(f(x))\right] = \frac{1}{f(x)} \cdot f'(x)$

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6. PRODUCT: $\frac{d}{dx}\left[f(x) \cdot g(x)\right] = f(x) \cdot g'(x) + g(x) \cdot f'(x)$

$1^{st} \cdot \text{der } 2^{nd} + 2^{nd} \cdot \text{der } 1^{st}$

7. QUOTIENT: $\frac{d}{dx}\left[\frac{\overset{\text{TOP}}{f(x)}}{\underset{\text{BOT}}{g(x)}}\right] = \frac{\text{BOT} \cdot \text{der TOP} - \text{TOP} \cdot \text{der BOT}}{\text{BOT}^2}$

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8. CONSTANTS $\frac{d}{dx}\left[c f(x)\right] = c f'(x)$ $\frac{d}{dx}\left[c \pm f(x)\right] = f'(x)$

ex: $f(t) = \ln(t^2+1)$ 5

ex: $f(w) = \ln(\cos(w-1))$ 5, then 4B

ex: $f(x) = \dfrac{x}{1+\ln x}$ 7, 5

p136 1-15 odd, 21, 29-32

1) 8:30 - 9:31
2) 9:36 - 11:32
3) 11:39 - 12:43
Lunch 12:48 - 1:18
4) 1:23 - 2:24
5) 2:29 - 3:30

3) $f(x) = \ln e^{2x} = 2x$

$f'(x) = 2$

11) $f(x) = \overset{\ln(f(x))}{\ln(e^{ax}+b)}$

$$f'(x) = \underbrace{\frac{1}{e^{ax}+b}}_{\frac{1}{f(x)}} \cdot \underbrace{\frac{e^{ax}\cdot a}{1}}_{f'(x)} = \frac{ae^{ax}}{e^{ax}+b}$$

5) $f(x) = \dfrac{1}{\ln x}$

$$f'(x) = \frac{\ln x \cdot 0 - 1\cdot\frac{1}{x}}{(\ln x)^2} = \frac{-\frac{1}{\cancel{x}}}{(\ln x)^2}\cdot\frac{\cancel{x}}{x}$$

$$= \frac{-1}{x(\ln x)^2}$$

$$f(x) = (\ln x)^{-1} \qquad f'(x) = -1(\ln x)^{-2} \cdot \frac{1}{x}$$

$$\underbrace{}_{(f(x))^n} \qquad n(f(x))^{n-1} \cdot f'(x)$$

$$= \frac{-1}{x(\ln x)^2}$$

30) $y = \overbrace{2x(\ln x + \ln 2)}^{\text{PRODUCT}} - 2x + e$

$$y' = \underbrace{\cancel{2x}\left(\frac{1}{\cancel{x}}\right) + (\ln x + \ln 2) \cdot 2 - 2}\ + 0$$

$$y' = \cancel{2} + (\ln x + \ln 2)2 - \cancel{2}$$

$$y' = 2(\ln x + \ln 2)$$

7) $f(x) = \ln(1 - e^{-x}) = \dfrac{1}{1 - e^{-x}} \cdot \dfrac{+e^{-x} \cdot (+1)}{1}$

5, (2)

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

32) $f(t) = \overbrace{\ln(\ln t)}^{\text{Rule 5}} + \overbrace{\ln(\ln 2)}^{\text{constant}}$

$$f'(x) = \frac{1}{\ln t} \cdot \frac{1}{t} + 0 = \frac{1}{t \ln t}$$

$$\frac{d}{dt}(\ln f(t)) = \frac{1}{f(t)} \cdot f'(t)$$