

HW 4.5 Questions #17, #33, #69, #73, #75

17) $f(x) = (x^2+1) \ln x$ (Can you clean up Algebra?)

Step 1] Choose rule! Use Product because of multiplication

Step 2] then choose $f = x^2+1$ and $g = \ln x$
 $f' = 2x$ $g' = \frac{1}{x}$

Step 3] Cross multiply x
 $f'g + g'f = 2x \cdot \ln x + \frac{1}{x} \cdot (x^2+1)$

Step 4] Simplify: $2x \cdot \ln x + x + \frac{1}{x}$

33) $S(x) = \ln(4x-2)^{1.3}$

Step 1] Can I clean up Algebra?

Step 2] Find $S'(x) = \frac{1}{(4x-2)^{1.3}} \cdot \frac{d}{d} (4x-2)^{1.3}$ } Chain Rule

Step 3] $\frac{d}{d} (4x-2)^{1.3} = 1.3(4x-2)^{0.3} (4)$

Step 4] $= \frac{1.3(4x-2)^{0.3} (4)}{(4x-2)^{1.3}} = \frac{5.2}{(4x-2)^1} = \frac{5.2}{4x-2}$

What happens without simplifying Algebra first?

With Algebra simplification first:

$S(x) = 1.3 \ln(4x-2)$

$S'(x) = 1.3 \cdot \frac{1}{4x-2} (4)$

$S'(x) = \text{Simplified}$

$\frac{5.2}{4x-2}$

Example

If $5 \ln 2$

just a #
 so $= 5 \cdot \ln 2$

Rule:

Ex: $\ln x^r$ already gives us permission to bring power (r) down.

so \equiv same as $r \ln x$. Since \ln already there.

(69) $f(x) = \frac{1}{x \ln x}$ Step 1 Cannot clean up Algebra, so choose rule = Quotient b/c

Step 2 $\begin{matrix} f = 1 \\ f' = 0 \end{matrix}$

$g = x \ln x$ division

$g' =$ Use Product rule, so $f = x$ $g = \ln x$

$\frac{f'g - g'f}{g^2}$

Step 3 $\frac{0(x \ln x) - (\ln x + 1) \cdot 1}{(x \ln x)^2} = \frac{-\ln x - 1}{(x \ln x)^2}$ Final Answer Step 2 $\begin{matrix} f' = 1 \\ g' = \frac{1}{x} \end{matrix}$

Example $y = \frac{(3x-1)^4 (5x+2)^7}{(7x-2)^8}$ Rule: $\ln xy = \ln x + \ln y$

so $\ln y = \ln \left(\frac{(3x-1)^4 (5x+2)^7}{(7x-2)^8} \right)$

$\ln y = \ln(3x-1)^4 + \ln(5x+2)^7 - \ln(7x-2)^8$

now bring all powers down, so

$\ln y = 4 \ln(3x-1) + 7 \ln(5x+2) - 8 \ln(7x-2)$

Special case called (Implicit) ↓ derivative ↓ $\frac{7 \cdot 5}{(5x+2)}$ ↓ $\frac{8 \cdot 7}{(7x-2)}$

$\frac{4 \cdot 3}{3x-1} + \frac{7 \cdot 5}{(5x+2)} - \frac{8 \cdot 7}{(7x-2)}$

$y' = \ln y = \frac{12}{(3x-1)} + \frac{35}{(5x+2)} - \frac{56}{(7x-2)}$

Example $y = 3x^2$ $y' = 6x$

73) $f(x) = \ln|\ln x|$

Step 1 $f'(x) = \frac{1}{\ln x}$ } 1st piece

Step 2 Chain rule: Derivative of inside piece

$\frac{d}{dx} \ln x = \frac{1}{x}$ } 2nd piece

Step 3 Combine pieces: $\frac{1}{x \ln x}$

Example $f(x) = \ln|\ln 7x|$
 $f'(x) = \frac{1}{\ln 7x} \cdot \frac{d}{dx} \ln 7x$

Final answer: $\frac{1}{\ln 7x} \cdot \frac{1}{7x} \cdot \frac{7}{1} = \frac{1}{x \ln 7x}$

75) $g(x) = \ln \sqrt{\ln x} = \text{same as } \ln(\ln x)^{1/2}$

Step 1 Algebraically - bring down power, so $\frac{1}{2} \ln(\ln x)$

Step 2 $f'(x) = \frac{1}{2} * \frac{1}{\ln x} * \frac{d}{dx} \ln x$

Step 3 $f'(x) = \frac{1}{2x \cdot \ln x}$