

1. Using logarithm rules, write all of the following expressions in terms of $\ln(3)$, $\ln(5)$, and $\ln(7)$.

a) $\ln(5^5 * 3 * 7^8)$

b) $\ln(5 * 7/3^2)$

c) $\ln(9 * 5 * 5 * 7) - \ln(3 * 5^2)$

d) $\ln(15 * 3^2 * 7)$

2. Differentiate the following expressions (logarithm rules will probably help you).

a) $\ln(xe^x - x)$

b) $\ln((x + 1)(x - 1)e^x)$

c) $e^{\ln(3+x+x^2)}$

3. Differentiate the following expressions. Show your work at each step by writing the rule (log, product, composition, etc) that you are using to move to the next step.

a) $\ln(3x)(x^2 + 2x + 1)$

b) $\ln(x^2 + 3)e^{x^5 - 2x + 1}$

c) $e^{\ln(x^2 - 3)(x^2 - 3)}$

d) $\ln(e^{9x+9-9x^2}e^{3x+2}e^5(x^2)(x^2 - 1))$

4. Calculate the derivative of $\ln(e^{3x+1})$ in two ways (a) simplifying first with log rules then differentiating and (b) differentiating directly with composition rule. Check the two are the same.

5. As in Question 4, calculate the derivative of $\ln(3x^4)$ in two ways (log rules first, or composition directly) and verify they are the same.

6. (challenge problem) Use the fundamental theorem of the derivative to check that the rate equation

$$f'(x) = \frac{1}{x}$$

$$f(1) = 0$$

has only one solution. (hint: if you have another solution $g(x)$, check that $f(x) - g(x)$ is the constant zero).