Differentiation of Logarithmic Functions

W-up: Without a calculator, evaluate $f'(1)$ when $f(x)=\sqrt[3]{\frac{3x-4}{x^2}}$

Logarithmic Rule for Differentiation

$$\frac{dy}{dx}\log_b u=\frac{1}{u}\frac{du}{dx}\bullet\frac{1}{\ln b}$$

Note: ALWAYS USE PROPERTIES TO REWRITE LOGARITHMS TO HAVE NO POWERS, PRODUCTS OR QUOTIENTS **BEFORE** DIFFERENTIATION!

EX) Differentiate each function below.

A) $f(x)=\ln(4x-2)$

B) $f(x)=\log_2(x^2-4)^4$

C) $f(x)=\log(x^2\sin x)$

D) $f(x)=\ln\sqrt[3]{\frac{3x-4}{x^2}}$

What is the domain of each function? Graph on the graphing calculator to verify your answers. Lastly, find $f'(1)$ using these graphs.

1) $f(x) = \ln(x)$ 2) $f(x) = \ln|x|$

Note: When finding the logarithm of an expression inside of absolute values the domain becomes NEARLY all real numbers. But, when finding the derivative follow the rule established above, WITHOUT the absolute value symbols.

EX) Differentiate $f(x) = \log_2|x^2 - 4|$

Using Logarithms to Differentiate Complex Rational Expressions

Differentiate complex rational expressions by taking the "ln" of both sides and differentiating. Lastly, solve for $\frac{dy}{dx}$ by multiplying through the equation by y.

Note: Result will be an implicit derivative.

EX) Differentiate $f(x) = \sqrt[3]{\frac{3x-4}{x^2}}$

$f(x) = x^2$ is known as a _____ expression.

$f(x) = 2^x$ is known as an_____ expression.

$f(x) = x^x$ is NEITHER! We must use logarithms to get this expression out of this form before differentiating!

EX) Differentiate $f(x) = x^{3x^2}$ to find the slope of the tangent line when $x = e$.