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## 11.1: Derivatives of Logs

If  $f(x) = \ln(x)$ , then  $f'(x) = \frac{1}{x}$

Ex1: Find the derivative.

a)  $4x^7 - 2\ln(x) = y$

b)  $f(x) = 3x^4 \ln(x)$

c)  $g(x) = \frac{x^2}{\ln(x)}$

If  $f(x) = \ln(u(x))$ , then  $f'(x) = \frac{1}{u(x)} \cdot u'(x)$  (chain rule)

Ex2: Find the derivative.

a)  $y = \ln(x^4)$

b)  $f(x) = \ln(x^3 - x + 7)$

Ex3:  $\frac{d}{dx} \ln\left(\frac{2x^4}{(5x+7)^5}\right)$

## Log Rules

Let  $m, n > 0$  and  $p \in \mathbb{R}$  and  $b > 0, b \neq 1$ .

I)  $\ln(e^x) = x$

II)  $e^{\ln(x)} = x, x > 0$

III)  $\ln(mn) = \ln(m) + \ln(n)$

IV)  $\ln\left(\frac{m}{n}\right) = \ln(m) - \ln(n)$

V)  $\ln(m^p) = p \ln(m)$

VI)  ~~$\log_b(x) = \frac{\ln(x)}{\ln(b)}$~~   
 $\log_b(x) = \frac{\ln(x)}{\ln(b)}$

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Ex 3 rev:  $\frac{d}{dx} \ln \left( \frac{2x^4}{(5x+7)^5} \right)$

Ex 4: Find the derivative:

a)  $s = \ln [e^3 (t^2 - 1)]$

b)  $y = \ln \left[ \sqrt[4]{\frac{3x+2}{x^2-5}} \right]$

c)  $f(x) = \ln [x^2 (x^4 - x + 1)]$

Ex 5: If the cost for  $C(x) = 1500 + 200 \ln(2x+1)$  where  $x$  is the number of units produced

a) Find  $\overline{MC}$

b) Find  $\$$  Interp  $\overline{MC}(100)$

c) Does  $C(x)$  always increase.

Ex 6: Between 1976 & 98, the percent of moms who recanted to wk w/in 1yr of having a baby was  $w(x) = 1.11 + 16.94 \ln(x)$  ( $x$  in yrs since 1970). What will be the ROC in 2005?

Ex 7: Find the derive.

a)  $y = \log_4(x)$

b)  $y = \log_6(x^4 - 4x^3 + 1)$