

L4 (Appendix p.571) The Derivative of General Logarithmic Functions

$$\text{If } y = \log_b x, \text{ then } y' = \left(\frac{1}{x}\right)\left(\frac{1}{\ln b}\right) = \frac{1}{x \ln b}$$

$$\text{If } y = \log_b [g(x)], \text{ then } y' = \left(\frac{1}{g(x)}\right)(g'(x))\left(\frac{1}{\ln b}\right) = \frac{g'(x)}{g(x) \ln b}$$

Ex1: Find  $y'$ .

a)  $y = \log_3(6x)$

$$y' = \frac{1}{x \ln(3)}$$

b)  $y = \log \sqrt[3]{x^4}$

$$y = \log(x^{\frac{4}{3}})$$

$$y = \frac{4}{3} \log(x)$$

$$y' = \frac{4}{3(\ln 10)(x)}$$

c)  $y = \sqrt{\log x}$

$$y = (\log x)^{\frac{1}{2}}$$

$$y' = \frac{1}{2} (\log x)^{-\frac{1}{2}} \cdot \frac{1}{x \ln 10}$$

$$y' = \frac{1}{2(\ln 10)(\log x)^{\frac{1}{2}} x}$$

d)  $y = \frac{\log_2 4x^3}{e^{5x}}$

$$y = \log_2 4x^3 \cdot e^{-5x}$$

$$y' = \frac{3x^2}{x^3 \ln 2} \cdot e^{-5x} + \log_2 4x^3 \cdot e^{-5x} (-5)$$

$$y' = \frac{3x^2}{x^3 \ln 2 e^{5x}} - \frac{5 \log_2 4x^3}{e^{5x}}$$

$$y' = \frac{3x^2 - 5 \ln 2 x^3 \log_2 4x^3}{\ln 2 x^3 e^{5x}}$$

Ex2: How would you differentiate  $y = x^x$  ?

Hmmmm.....



$$\ln y = \ln x^x$$

$$\ln y = x \cdot \ln x$$

$$\frac{1}{y} y' = \ln x + 1$$

$$y' = y(\ln x + 1)$$

$$y' = x^x (\ln x + 1)$$

Assigned Work:

p.578 #1-5  
#7,9,11