

## 3.7

1. The differentiation formula for logarithmic functions,  $\frac{d}{dx}(\log_a x) = \frac{1}{x \ln a}$ , is simplest when  $a = e$  because  $\ln e = 1$ .

$$2. f(x) = \ln(x^2 + 10) \Rightarrow f'(x) = \frac{1}{x^2 + 10} \frac{d}{dx}(x^2 + 10) = \frac{2x}{x^2 + 10}$$

$$5. f(x) = \log_2(1 - 3x) \Rightarrow f'(x) = \frac{1}{(1 - 3x) \ln 2} \frac{d}{dx}(1 - 3x) = \frac{-3}{(1 - 3x) \ln 2} \text{ or } \frac{3}{(3x - 1) \ln 2}$$

$$6. f(x) = \log_{10}\left(\frac{x}{x-1}\right) = \log_{10} x - \log_{10}(x-1) \Rightarrow f'(x) = \frac{1}{x \ln 10} - \frac{1}{(x-1) \ln 10} \text{ or } -\frac{1}{x(x-1) \ln 10}$$

$$10. f(t) = \frac{1 + \ln t}{1 - \ln t} \Rightarrow$$

$$f'(t) = \frac{(1 - \ln t)(1/t) - (1 + \ln t)(-1/t)}{(1 - \ln t)^2} = \frac{(1/t)[(1 - \ln t) + (1 + \ln t)]}{(1 - \ln t)^2} = \frac{2}{t(1 - \ln t)^2}$$

$$20. y = \ln(\sec x + \tan x) \Rightarrow y' = \frac{\sec x \tan x + \sec^2 x}{\sec x + \tan x} = \sec x \Rightarrow y'' = \sec x \tan x$$

$$35. y = (\ln x)^x \Rightarrow \ln y = \ln(\ln x)^x \Rightarrow \ln y = x \ln \ln x \Rightarrow \frac{y'}{y} = x \cdot \frac{1}{\ln x} \cdot \frac{1}{x} + (\ln \ln x) \cdot 1 \Rightarrow$$

$$y' = y \left( \frac{x}{x \ln x} + \ln \ln x \right) \Rightarrow y' = (\ln x)^x \left( \frac{1}{\ln x} + \ln \ln x \right)$$

$$36. y = x^{\ln x} \Rightarrow \ln y = \ln x \ln x = (\ln x)^2 \Rightarrow \frac{y'}{y} = 2 \ln x \left( \frac{1}{x} \right) \Rightarrow y' = x^{\ln x} \left( \frac{2 \ln x}{x} \right)$$