

# Exponential and Logarithm Derivatives

## Derivatives of Exp and Log

$$\frac{d}{dx} [e^x] = e^x$$

$$\frac{d}{dx} [\ln x] = \frac{1}{x}$$

$$\frac{d}{dx} [e^{f(x)}] = f'(x) e^{f(x)}$$

$$\frac{d}{dx} [b^x] = b^x \ln b$$

$$\frac{d}{dx} [\log_b x] = \frac{1}{x \ln b}$$

$$\frac{d}{dx} [\ln(f(x))] = \frac{f'(x)}{f(x)}$$

## Logarithmic Differentiation

$$\frac{d}{dx} [f(x)] = f(x) \left( \frac{d}{dx} \ln(f(x)) \right)$$

$$\frac{d}{dx} [f(x)^{g(x)}] = g(x) f(x)^{g(x)-1} f'(x)$$

$$\frac{d}{dx} \ln(fg) = \frac{f'}{f} + \frac{g'}{g} \quad \frac{d}{dx} \ln(f^n) = n \frac{f'}{f}$$

$$+ g'(x) f(x)^{g(x)} \ln f(x)$$

1. Compute derivatives of the following exponential functions.

A.  $f(x) = x^3 e^{2x}$

B.  $f(x) = e^{(2x^3)}$

C.  $f(x) = (e^{2x})^3$

D.  $f(x) = \sin(e^x)$

E.  $f(x) = x^3 3^x$

F.  $f(x) = \frac{e^x - e^{-x}}{2x}$

2. Compute derivatives of the following logarithm functions.

A.  $f(x) = (2x + 1) \ln x$

B.  $f(x) = \ln(2x + 1)$

C.  $f(x) = \ln(\ln x)$

D.  $f(x) = \ln(\tan(x))$

E.  $f(x) = (\ln x)^2$

F.  $f(x) = \ln(\ln x)^2$

**3.** Use logarithmic differentiation to write the derivative.

A.  $\frac{d}{dx} \left[ \frac{(2x+1)^2 x^3}{(x^2+1)^5} \right]$

B.  $\frac{d}{dx} \left[ \frac{(x^2+2)^4}{(x-1)^2 (x^2+4)^5} \right]$

C.  $\frac{d}{dx} \left[ \frac{\sqrt{x^3+x^2} (5x-3)^2}{(2x+4)^9} \right]$

D.  $\frac{d}{dx} \left[ (2x+3)^{4x+5} \right]$

E.  $\frac{d}{dx} \left[ (\sec x)^{\tan x} \right]$

F.  $\frac{d}{dx} \left[ (\ln x)^{x^4} \right]$