

Differentiation Techniques

Assume that c and n are real numbers and f(x), g(x), and u(x) are any differentiable functions of x:

1.
$$\frac{d}{dx}(c) = 0$$

2.
$$\frac{d}{dx}(x^{n}) = nx^{n-1} \text{ (power rule)}$$

3.
$$\frac{d}{dx}(cf) = c\frac{df}{dx}$$

4.
$$\frac{d}{dx}(f \pm g) = \frac{df}{dx} \pm \frac{dg}{dx}$$

5.
$$\frac{d}{dx}(fg) = g\frac{df}{dx} + f\frac{dg}{dx} \text{ or } (fg)' = gf' + fg' \text{ (product rule)}$$

6.
$$\frac{d(f/g)}{dx} = \frac{g\frac{df}{dx} - f\frac{dg}{dx}}{g^{2}} \text{ or } \left(\frac{f}{g}\right)' = \frac{gf' - fg'}{g^{2}} \text{ (quotient rule)}$$

7.
$$\frac{d[u(x)]^{n}}{dx} = n[u(x)]^{n-1}\frac{d(u(x))}{dx} \text{ (general power rule - chain rule)}$$

8.
$$\frac{d(e^{x})}{dx} = e^{x}$$

9.
$$\frac{d(\ln x)}{dx} = \frac{1}{x}$$

10.
$$\frac{d(e^{u(x)})}{dx} = e^{u(x)}\frac{d(u(x))}{dx}$$

11.
$$\frac{d[\ln(u(x))]}{dx} = \frac{1}{u(x)}\frac{d(u(x))}{dx}$$

12.
$$\frac{d(a^x)}{dx} = a^x \ln a$$
 13.

14.
$$\frac{d(a^{u(x)})}{dx} = a^{u(x)} \ln a \frac{d(u(x))}{dx}$$

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 $\frac{d(\log_a x)}{dx} = \frac{1}{x \ln a}$

15.
$$\frac{d(\log_a u(x))}{dx} = \frac{1}{u(x)\ln a} \frac{d(u(x))}{dx}$$

